THURSDAY, DECEMBER 8, 1898.

PHYSIOLOGICAL SELECTION.

Darwin, and after Darwin. By Dr. G. J. Romanes. Pp. viii + 181. (London: Longmans, Green, and Co., 1897.)

THIS third volume concludes the series "Darwin, and after Darwin" of which G. J. Romanes had published the first volume and had planned and mostly written the remaining two, at the time of his death. This volume, as well as the second, has been prepared for the press under the able editorship of Prof. Lloyd Morgan, who has performed a difficult task with conspicuous success. In a brief preface we are told that the first two chapters and the last were in type at the time of the author's death, and remain practically unchanged; while the editor is responsible for the selection and arrangement of the remaining three. The Appendices A and B, bearing upon the controversy with Alfred Russel Wallace, "remain in accordance with the author's expressed injunctions." The frontispiece to the volume is a portrait of the Rev. J. T. Gulick, whose most interesting researches into the variation of the land-shells of the Sandwich Islands led him, independently, to a theory closely similar to that of "physiological selection."

Of all the three volumes of this series, this possesses the greatest personal interest; for it is devoted to the exposition and discussion of the evidence for and against the much debated hypothesis of physiological selection, which, although never widely accepted, always remained dear to its creator. The present volume, which possesses many advantages over the original account of the hypothesis published in the Linnean Society's Journal, will do much to enable biologists clearly to grasp the author's meaning.

The two first chapters deal with "isolation" in general, a principle which was given a position of the utmost importance by the author, who regarded not only his own physiological selection, but natural selection itself as a special form of isolation. The third, fourth and fifth chapters deal with "physiological selection" and its evidences; the sixth again returns to "isolation" as a factor in "organic evolution," and also contains the "general conclusions." Appendix A contains Mr. Gulick's criticism of Mr. Wallace's views on physiological selection; B, an examination by Mr. Fletcher Moulton of a calculation by Mr. Wallace on the same subject; C, "some extracts from the author's note-book."

In the discussion of isolation the author first distinguishes between *indiscriminate* isolation such as would be produced by some sudden geographical change separating the individuals of a species into two detachments, and *discriminate* isolation such as would be caused by a part of the species seeking some new area, or some different habitat on the same area. While Mr. Gulick recognised this distinction under the terms "separate breeding" and "segregate breeding," the author suggests "apogamy" and "homogamy." He says, moreover, with the exception of Mr. Gulick, I cannot find that any other writer has hitherto stated this supremely important distinction between isolation as discriminate and indiscriminate." But the classes of facts to which he alludes are distinguished by every writer and thinker on evolution: the only difference being that the author is peculiar in making isolation the basis of his classification. Other writers have used the term "isolation" for the cases in which separation is the primary and essential factor, viz. for "indiscriminate isolation" only; "discriminate isolation" they have classified as "natural selection" or as "Lamarckian evolution," as the case may be, the separation being regarded as a secondary result.

The whole discussion of isolation in the exalted position in which it is placed by the author ("the whole theory of organic evolution becomes neither more nor less than . . . a theory of the causes which lead to discriminate isolation," p. 6) is interesting and suggestive, and a large part of it convincing. It is also for the most part clear and lucid in treatment, although sentences occur which seem unnecessarily to demand the strained attention of the reader. Thus after arguing that diversification of character is *promoted* but never *originated* by natural selection, the author concludes, in the following complicated passage:

"Therefore the change must in all cases have been due, in the first instance, to some other form of isolation than the superadded form which afterwards arose from superior fitness in the possession of superior benefit—although, so long as the prior form of isolation endured, or continued to furnish the necessary condition to the co-operation of the survival of the fittest, survival of the fittest would have continued to increase the divergence of character in as many ramifying lines as there were thus given to its action separate cases of isolation by other means" (p. 32).

The ideas sought to be conveyed in this quotation are not difficult of comprehension, but the form is such that they become intelligible only with effort.

Physiological selection is defined by the author at the opening of the third chapter as "that form of isolation which arises in consequence of mutual infertility between the members of any group of organisms and those of all other similarly isolated groups occupying simultaneously the same area." The two great difficulties in the way of natural selection as a sufficient explanation of the origin of species are held to be the difference between domesticated varieties and natural species in respect to cross fertility, and "the fact that natural selection cannot possibly give rise to polytypic as distinguished from monotypic evolution." The former difficulty has long been felt, and it was the great logical flaw which always prevented Huxley from declaring his entire conviction in the soundness of the theory. The author is certainly right in claiming for physiological selection that it would tend towards the removal of this difficulty. As to the second difficulty the majority of Darwinians will not be convinced by the author's reasons for thus limiting the power and scope of natural selection.

The conception of physiological selection—the idea that the differentiation of species begins with infertility instead of ending with it—is here shown to have arisen independently in many minds, having been first mentioned by Belt (1874), then by Catchpool (1884), Romanes (1886), and Gulick (1887).

To the present writer it has always appeared that the suggestion is an extremely interesting and ingenious one, the chief objection being the immense difficulty in proving that it actually exists or has ever existed as an operative principle. If it exists, then much that is claimed for it would follow. We know that geographical isolation is followed by differentiation, and many evolutionists are prepared to admit that some of the minor differences thus produced may be independent of natural selection. Most naturalists would probably be inclined thus to explain the differences between the land-shells of adjacent valleys in the Sandwich Islands as described by Gulick. Those who believe in physiological selection consider that what is here brought about through the prevention of interbreeding by geographical barriers, is produced on continuously peopled areas by the physiological barrier of infertility.

This conclusion is capable of being tested to a certain extent by an investigation of the degree of infertility between species which are known to have been produced in the former manner and those (of approximately equal differentiation) which are believed to have been produced in the latter. Apart from its application to the present controversy such an inquiry would be of great interest in itself.

The results of such an investigation would be far more convincing than the elaborate and often very ingenious arguments of the writer, many of which are capable of an immediate and satisfactory answer. For instance on pp. 48, 49, he asks how it is that the reproductive system is always affected "in the same peculiar way," viz. so as to produce mutual sterility, between different species of all kinds, animal and vegetable, separated by morphological differences of infinite variety. It is evident that he regards this question as unanswerable except on the view that the infertility is the invariable precursor and condition of the differentiation. But the facts can readily be explained otherwise. Mutual fertility depends upon the exact relotionship of two extraordinarily complex bodies, the germ-cells of male and female; it depends upon a reciprocal adjustment of almost infinite precision. Single individual variations receding from the necessary precision continually arise, but are infallibly exterminated. Such variations are not to be looked upon as due to a single and uniform change in the complex material of the germ-substance. The opposite point of view is the truer: mutual fertility is due to a single and uniform constitution rigidly kept within the narrowest limits, while a minute change of constitution *in any direction* means infertility. Mutual infertility is, in fact, but the single external indication of numberless changes of constitution. The necessary precision of adjustment of the male to the female germ-substance is only kept up in the species by unremitting selection, and there is no cause for surprise that it should cease when selection is no longer forthcoming for its support. These considerations seem at first sight to indicate that mutual fertility between domestic breeds is a matter for greater wonder than the infertility between natural species. We cease to wonder, however, when we reflect upon the length of time which must have elapsed since the separation of natural species such as the horse and ass, which are nevertheless fertile when crossed, although their hybrid progeny is sterile. Since this is the case the mutual fertility of our modern domestic races, so far as it has been proved to exist, is only what we should have been led to expect. In this relationship the present writer has often considered that further experiments upon these latter would be of great value, especially in the case of races in which the morphological differences have been carried to a very high degree—so much so, indeed, that artificial fertilisation would probably be necessary.

The argument which has been met in the last paragraph is evidently one on which the greatest stress is laid. Thus we again read on p. 51 of "this one peculiarity of the reproductive system," viz. mutual infertility; and on pp. 52, 53, it is made a chief support for the hypothesis of physiological selection, a good brief account of which will here be found. Throughout the whole work we meet with the same insistence on "this constant primary distinction," "the same peculiar change," &c., as one main foundation for the hypothesis.

If space had permitted, many other interesting points raised in this volume might have been discussed. It is of great service to the student of evolution that the hypothesis of physiological selection, the arguments for it and evidence which supports it, should have been brought forward in so readable a form. The work is printed in pleasant type, and has been so carefully seen through the press, that there are practically no printer's mistakes. E. B. P.

THE THEORY OF GROUPS.

Theory of Groups of Finite Order. By W. Burnside, M.A., F.R.S. Pp. xvi + 388. (Cambridge University Press, 1897.)

THE theory of groups of finite order is one to which in very recent times the attention of mathematicians has again and again been directed. Until a little time ago any one who wished to become acquainted with the elements of the theory would have been referred to J. Serret's "Algebra," to C. Jordan's comprehensive "Traité des substitutions," and to E. Netto's introductory work on the same subject. No one who takes account of the time at which it was written will wish to depreciate the merits of the first of these, but the chapters dealing with groups consist of a series of extracts reproduced from the original memoirs of the masters to whom we owe this branch of mathematics: these extracts are chosen with all the knowledge of an expert as to what should be chosen, but are not worked up. C. Jordan brings together an overpowering wealth of material, which for the most part has its origin in his own researches; but there can scarcely ever have been any one who would be in a position to work through the treatise from beginning to end; or who could without guidance from some other source separate the fundamental portions from the mass of detail. Lastly, Netto's book on substitutions is now fifteen years old; it still forms a useful introduction to the subject, but it goes no further than that.

The most modern treatises on algebra mete out varying treatment to the theory of groups. Netto leaves it on one side altogether; Drach makes the interesting experiment of attempting to build up the elements of

algebra by a consecutive formulation of Kronecker's abstractions without using the notion of a limit, and restricts himself in the process to those parts of the group-theory that are necessary for his purpose ; Vogt provides for French readers an equivalent of what Netto, in his older book, and Netto's translators, Battaglini and Cole, had given to Germans, French, and English ; in Weber's great treatise the theory appears as an important aspect, but still only an aspect, of the problem of algebra. For all these books the theory of groups is a means to an end, or rather to one of multifarious ends which it can be called upon to serve, viz. the algebraic solution of equations.

But in course of time the theory of groups has ever more and more emancipated itself from algebra, whose servant it originally was. Years ago Cayley threw out, though he did not develop, the fundamental idea that the notion of a group, in and for itself, is in no way bound up with permutations and substitutions, but arises whenever the effect of two operations performed successively upon an object is the same as that of a single operation of the same kind. In the general theory of groups thus founded, groups of finite order form a well-marked division. To bring together the great mass of single results yielded by exploring this division of the theory from different sides, to take a comprehensive view of them, and to exhibit them in a well-digested form, is the problem that has been attempted for the first time in the book before us, and it is solved in the happiest manner.

The author does not push abstraction to the point of banishing from his book all concrete methods of representation of groups. He frequently uses properties of groups of substitutions, in particular, not merely with a view to making results plain to intuition, but also for the deduction from them of properties of groups in the abstract. He himself asks the question why other particular methods of representation of a group, *e.g.* by means of homogeneous linear transformations, are not employed in a similar way, and he answers it, as I think rightly, in the words "that, while in the present state of our knowledge, many results in the pure theory are arrived at most readily by dealing with properties of substitution groups, it would be difficult to find a result that could be most directly obtained by the consideration of groups of linear transformations."

Believing that familiarity with symbolical calculations concerning interchanges of letters is not to be assumed on the part of his countrymen, the author gives a sketch of this theory in a short first chapter. The second chapter begins with Cayley's abstract definition, cited above, and carries the development of the general properties of a group as far as Dyck's theorem to the effect that every group of finite order N can be represented as a group of interchanges of N symbols. The third chapter develops the notions: sub-group, self-conjugate sub-group, simple group, isomorphism, factor groups. Then follow in chapters four and five special investigations relating to Abelian groups and to groups whose order is a prime number ; in the latter the author has placed a series of results of his own researches. The sixth chapter brings us back with Sylow's theorem to the general theory, and the pivot of the theory is found, in chapter seven, in the theorems on the composition-series of a group. The three following chapters are especially concerned with groups of substitutions, with the questions of their transitivity and primitivity ; in addition to the general theorems, they contain a great number of completed researches on special groups and types of groups ; some of these are of intrinsic interest, and others serve as vivid illustrations of the general theory. The eleventh chapter treats of the isomorphism of a group with itself on the lines followed by Hölder and Frobenius. In the twelfth and thirteenth chapters is explained the method of representation of a group which was developed in a general manner by Dyck, viz. the representation by means of geometrical transformations of a surface divided into regions, and especially by the transformations effected by linear relations between complex variables. An older method, due to Cayley, of representation by coloured diagrams leads in simple cases to results easier to appreciate at a glance ; this method also is here expounded and illustrated by a beautifully executed coloured plate. The fourteenth chapter treats of the representation of a group by means of systems of linear congruences. There is a certain incongruity in the fact that while this is inserted, the representation by means of systems of linear equations is omitted ; but the theory of this method would by itself furnish material for a second book as large as the one before us. Perhaps the author will some day give us such a book. On the other hand we find here the extension of the theory named to congruences holding among Galois' imaginaries. This was cultivated in his time by E. Mathieu, and has been taken up recently by E. H. Moore and the author of this treatise, in whose hands it has led, among other remarkable results, to the knowledge of a new series of types of finite groups. Finally the last chapter gives an account of the most modern enumerations of types of groups, in particular of simple groups of an order which can be expressed in a prescribed manner as a product of primes.

The author has not attempted to give historical references concerning the discovery of the older theorems ; but for the more modern literature, of about the last twenty years, and right up to the time of publication, his references are full and trustworthy.

In respect of the completeness and exactness of its matter, the work fills in a very acceptable manner a gap in the literature of mathematics, and not merely of mathematics in England. It brings to the special subject a great wealth of material for the widening and deepening of knowledge ; while at the same time beginners, under expert guidance, will be able to make a profitable use of it.

H. BURKHARDT.

OUR BOOK SHELF.

Radiation: an Elementary Treatise on Electro-magnetic Radiation, and on Röntgen and Cathode Rays. By H. H. Francis Hyndman, B.Sc. (Lond.). With a Preface by Prof. Silvanus P. Thompson, D.Sc., F.R.S. Pp. xviii + 307. (London: Swan Sonnenschein and Co., Ltd. New York: The Macmillan Co., 1898.)

THE author considers chiefly those portions of the subject which are somewhat neglected in most books, and in addition deals with the results of some of the

more recent investigations. Brief outlines are, however, given of those parts that are not especially treated, in order to maintain continuity and allow of a direct comparison of the properties of the different radiations. Many references are given to original sources, which enable the reader to extend more readily the narrow limits of the book.

The treatise contains an account of a large amount of interesting work, but it can scarcely be expected that one not perfectly familiar with the subject can follow the ideas so briefly expressed in many places.

Throughout the volume we are confronted with a considerable number of misleading and erroneous statements, the nature of which can be seen from a few examples. For instance, on p. 255 it is stated :—"That the rays do not themselves act as conductors seems proved, for they can pass between bodies of very different potentials if these are not already connected by lines of force." Any comment on this is superfluous.

On p. 198 we read :—"The cathode rays possess the same power as the ultra-violet and the X-rays, of causing those gases which they traverse to become conductors of electricity." All careful experiments, however, show that ultra-violet light in traversing a gas does not produce any conductivity.

Again, on p. 259 it is stated that the cha rge carried by the ions in X-ray conduction can be calculated from the values of the saturation current and the time required for the conductivity of the gas to sink to half of its value. Such a calculation is not possible.

On p. 254, in regard to conduction produced by the passage of X-rays through bodies, we read that "paraffin, wax, sulphur, ebonite, mica, and all gases become conductors." It is now generally believed, however, that solid insulators are not made to conduct by the rays, and the author ignores this side of the question.

Strict accuracy in the facts presented is an essential of every scientific treatise, as the harm produced by the inception of erroneous ideas cannot be over-estimated.

J. Z.

Four-footed Americans and their Kin. By Mabel Osgood Wright. Pp. xv+432 ; illustrated. (London : Macmillan and Co., Ltd. New York : The Macmillan Company, 1898.)

WHATEVER difference of opinion may obtain as to whether the title of this little volume is the best that could have been found, or whether the "Mr. Barlow" style of "Sanford and Merton" is the most suitable for popular natural history, there can be no hesitation in according the highest praise to the exquisite illustrations which form its most attractive feature. In addition to being in every way artistic productions these, so far as we can judge, are absolutely life-like ; portraying the animals not only among their natural surroundings, but also in characteristic attitudes. Where none are bad, and all attain a high standard of excellence, it is almost invidious to make a selection ; but two of the illustrations which especially strike our fancy are the wood-hare on p. 141, and the little striped skunk on p. 181. It is rare, indeed, to meet with illustrations of such a high class, and these alone ought to give the book a large sale ; while the artist, Mr. E. S. Thompson, ought to obtain a world-wide reputation as a delineator of animal life.

But it is not on the illustrations alone that the book has to depend for popularity ; as, allowing for certain peculiarities in the style, the descriptions of the habits of the various animals mentioned are for the most part well written and entertaining. A classified synopsis at the end gives a clue to the identification of the species described ; and in this connection it is important to notice that in nearly all cases the author is thoroughly up to date as regards nomenclature. As changes in nomenclature have been necessary, it is most desirable that they should be adopted by popular writers. We must, however, take leave to object to the title of "Beef or Meat Family" for the *Bovidae*, as also of "Antelope Family" for the Prongbuck, and of "Leapers" for the *Leporidae*. Since, too, the *Viverridae* are conspicuous by their absence in America, the misnomer of "Civet-cat" is decidedly objectionable for the Cacomistle (*Bassariscus*), whose inclusion among the "Cousins of Cats" is scarcely warranted by the facts. As a Christmas present to all young persons interested in animals, the work may be confidently recommended.

R. L.

Electricity made Easy, by Simple Language and Copious Illustration. By Edwin J. Houston, Ph.D., and Arthur E. Kennelly, Sc.D. Pp. 348. (London : Swan Sonnenschein and Co., Ltd., 1898.)

SIMPLE descriptions and explanations of electrical appliances met in every-day life are given in this volume. Facts with regard to the nature and functions of electric mains, the distribution of currents, generating stations, the principles of incandescent and arc lighting, measurement of electric supply, electric bells, telegraphy, telephones, and other things concerned in the production and uses of electricity are stated in the simplest of words. Illustrations are given of the external and internal appearance of many of the appliances described. These pictures are, perhaps, a trifle too numerous, for they tend to give the volume the character of a catalogue of electric fittings.

The comparison of the flow of water with the flow of electricity is a useful one ; but there is a danger that the reader will carry the analogy too far. On p. 30, for instance, we read that electricity "flows through wires very much like water or gas flows through pipes, but flows through a solid wire as readily as through a tubular wire of the same weight." Brief statements of this kind are frequently the cause of serious misconceptions as to the nature of electricity.

Differential and Integral Calculus for Technical Schools and Colleges. By P. A. Lambert, M.A., Assistant-Professor of Mathematics, Lehigh University. Pp. x + 245. (New York : The Macmillan Company. London : Macmillan and Co., Ltd., 1898.)

THE first hundred pages of this book are occupied with the differentiation and integration of simple algebraic functions, including easy applications to geometry, and here and there a mechanical problem is set amongst the examples.

Then come chapters involving trigonometrical functions, and logarithmic and exponential functions, followed by a chapter containing applications to mass centres and moments of inertia. The next two chapters deal with expansions and applications of Taylor's theorem, and the last forty pages of the work are devoted to an outline discussion of certain simple classes of differential equations.

There are some good features in the book considered as an introductory text-book for ordinary school use where a good deal of supplementary oral teaching would be given. Thus the statement of methods and the proofs, or indications of proof, are clearly worded ; the examples are easy and straightforward, and in two or three cases distinctly fresh illustrations appear.

But the general treatment is very superficial ; far too much ground is covered ; there is an appearance of easy progress produced by the avoiding of the real difficulties which occur in the practical applications of the calculus. In fact, it is quite misleading to describe the work as specially adapted for technical schools and colleges. No instructor of an English technical class would consider this handbook an adequate introduction to the application of the calculus to physics or engineering.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Range of the Garefowl (Alca impennis).

IN 1856 the late Dr. Gray obtained for the British Museum an example of this extinct species from the collection of the late Prof. van Lidth de Jeude of Utrecht, and for some reason unknown to me had the locality "Labrador" painted on its stand. As I had been informed with certainty by the late Prof. J. T. Reinhardt that this specimen was one of those sent to Copenhagen from Iceland, I corrected the error in *The Natural History Review* of October 1865 (vol. v. p. 473, note), and the correction has since been generally accepted. It is therefore with some regret that I find the old error repeated in the recently published volume of the "Catalogue of the Birds in the British Museum" (vol. xxvi. p. 564), and the error is rather a serious one in the absence of evidence of the species having inhabited the coast of Labrador, as well as that of any skin of proved Transatlantic origin. I may also mention that on the same page of the "Catalogue," the date of Bullock's Orcadian specimen is wrongly given as 1812 instead of 1813.

ALFRED NEWTON.

Magdalene College, Cambridge, December 3.

Asymmetry and Vitalism.

THIS must be my last word on this subject, and it is only written because Prof. Japp asks me to correct him if I consider him wrong in his interpretation of my illustration of the separation of tetrahedral atoms. I apologise to him as a chemist if I used the word "compound" where I ought to have used "substance" or "mixture," although it seems to me Messrs. Kipling and Pope use the word compound in a perilously like sense in the eighth paragraph of their letter. The use of the word has nothing to do with the main argument, the chance production of the optically active "mixture," and then the production from the "mixture" of the optically active "compound" with only one enantiomorph. By the by, will Prof. Japp guarantee that all vital optically active substances are "compounds" in this sense, and not largely preponderating "mixtures"? I only put the question, rather irresponsibly in passing, owing to something a distinguished biologist let fall in my presence the other day. I am quite prepared to be told that this is as well demonstrated as the law of gravity. Now as to my illustration, I was certainly thinking of a spin from rest so that the tetrahedra start with an impulse relative to the fluid and further experience its resistance relative to their motion. Let us take the *simplest* possible case for an example. Suppose Z′ somewhat larger than Y′, both considerably larger than X′ and H negligible to a first approximation. Then I should expect Y′ to set itself nearly in the wake of Z′, and X′ to turn in towards the axis. Thus Z′, Y′, X′ would be in a plane perpendicular to the axis; this would bring H above for one type of tetrahedron and below for the other type, or we have differentiated the positions of right- and left-handed tetrahedra. However, I do not lay stress on the illustration, for whatever we do now to separate left- and right-handed tetrahedra, I take will be asymmetrical relative to the sense of the original spin, and accordingly if I am correct, I am only inventing a clumsy illustration of non-vital asymmetric force, of which Prof. Fitzgerald has already given a much better illustration in the earth's rotation. Will any physicist having the apparatus at his disposal kindly spin with great but *irregular* speed a couple of tetrahedra in a viscous fluid, the axis of the churn being horizontal? The balls at the angles of the tetrahedra, being arranged right- and left-handed and of masses somewhat as above, we should be able to settle whether a differentiation of position would or would not take place. I should not be surprised to hear that the two tetrahedra moved to opposite ends of the churn.

KARL PEARSON.

A Shag's Meal.

THE following observation on the habits of the shag (*Phalacrocorax graculus*), which frequents our coasts, is probably of interest in itself and not without bearing on the subject-matter of Mr. Lowe's letter (November 24).

On August 15 last, when at anchor in Wicklow harbour, in the course of a cruise, we noticed a shag alight upon the water at a short distance from our yacht. It was a very calm, bright day. What follows occurred within a distance of a cable's length or thereabouts of our boat; and as I observed the proceedings throughout by the help of a powerful "trieder binocle" (×9) of Goerz, and my companion, Dr. H. H. Dixon, possesses unusually keen sight and closely followed the events, there is no doubt as to the reality of what is here recorded.

The shag, after swimming about for a little, dived once or twice—apparently fruitlessly—but finally appeared with a large eel in his beak. The eel was big and strong, and twisted into the form of a figure 8, evidently an awkward morsel. The bird kept snapping and shifting it in his beak, till at length with a few violent gulps it swallowed the eel, the latter evidently going down alive. It was to be inferred, in fact, that the shag was not happy with so large a live eel in his crop, for he swam restlessly about, twisting and stretching his neck incessantly. Presently he dived again, was down perhaps twenty seconds, and came up with an eel as large as the first one. This writhed and twisted like its predecessor, and, after much snapping, finally suffered the same fate. The same uneasiness was displayed by the bird, and the bird once more dived.

Dixon and I were expressing some surprise at the rapidity with which our friend had caught the two eels, and also at his very considerable capacity to hold two such large eels—certainly not less than 15 inches long each—when the bird reappeared bearing a third eel, as big as its predecessors and engaged in the same violent resistance. The same snapping, same gulping, same uneasiness and down for a dive once again! This was the third eel.

While we were taking sympathetic breaths with the insatiable shag, the latter reappeared—yet again with a 15-inch eel. Evidently the harbour was so full of 15-inch eels that a shag had only to dive to pick one up. It was also evident that no language could be too strong in which to condemn such unmeasured license. Four 15-inch eels—all swallowed alive—within the space of about four minutes!

But this was only the beginning, as will presently appear. The bird went down again almost immediately after the fourth. We determined to keep careful count and, if possible, get the measure, in eels, of a shag's capacity. Would he bring up another? Yes, there he was again with another 15-inch eel! A very vigorous eel—just like the others in size and appearance, and swallowed in the same manner, after about 30 seconds' resistance. This made five eels.

The question now arose as to what would be the end of this bird. Was he going to die the death of King Henry I. before our eyes? We called him King Henry to distinguish him from other shags.

To make a long story short, we counted *twelve* eels!—all stout 15-inchers. The twelfth seemed, perhaps, rather feebler than the others, but still it nearly got away. For King Henry dropped it in a too vigorous snap, and only recovered it by a prompt plunge forwards. H.R.H. now seemed to reflect that this last misadventure was a warning, swallowed his twelfth, and took flight; disappearing in an easterly direction whence he had come.

There is, of course, only one explanation of all this: the twelve eels were one and the same eel. To suppose the bird caught and devoured twelve eels of this size in as many minutes appears to us incredible. His final appearance as he flew astern of us betrayed no signs of surfeit. He would have had at least two pounds' weight of eel within had he really eaten twelve such eels.

The peculiar procedure of ejecting the prey under water appears very remarkable. Perhaps the head-downward attitude of diving is requisite to effect this.

Has this mode of weakening or playing with his prey been recorded of the shag (or, indeed, of any animal) previously?

Trinity College, Dublin, November 27. J. JOLY.

Periodic Tides.

ATTENTION has lately been called by Mr. H. C. Russell, of Sydney Observatory, to what may be termed a tide of short period, which he has detected in the enclosed harbour of Sydney.

Mr. Russell traces a connection between this interesting

phenomenon and certain meteorological conditions obtaining at a distance. Looking to the position of Sydney Harbour, it is only natural that we should expect to find the origin of these undulations in the open ocean; but experience of similar phenomena in another part of the world leads me to think that the cause, whether meteorological or not, must be sought nearer at hand.

My attention was first drawn to these curious fluctuations of sea level when golf playing on the low sands at the head of the landlocked harbour of Lemnos in the Greek archipelago, on August 9, 1895. I noticed that the current in the shallow streams communicating with the sea appeared to reverse at intervals of about a quarter of an hour, without any apparent cause. On returning to Malta I inquired if anything similar had been noticed there, and in consequence of information then received, I commenced some observations on my own account.

It is a matter of common knowledge to naval officers and others concerned, that the irregular variations of sea level in the Maltese inlets are at times sufficiently great to completely mask the slight lunar tide; and that the Port Officials are in the habit of insisting on a considerable margin of depth before permitting vessels to pass over the sills of the dry docks. These extra tidal variations of sea level have been ascribed to various causes, such as the direction and strength of prevailing winds, currents setting towards the mouth of the inlet, or to what is vaguely called the natural period of the harbour. My observations showed conclusively that there is at certain times in Malta Grand Harbour a perfectly regular ebb and flow with a period of twenty-three minutes; about the same period obtaining in Sydney Harbour, which Mr. Russell gives as twenty-six minutes.

My observations were made in the neighbourhood of Magazine Point, about two-thirds of the distance from the sea to the head of Valetta Harbour, the width across the harbour at this spot being little more than 300 yards. On May 7, 1896, the to-and-fro movement of the water was very remarkable, being continuous from 8 a.m. till 2 p.m. Between these hours the water in this part of the harbour rose and fell with the utmost regularity, the range being about 15 inches and the interval between successive high waters about twenty-three minutes. This variation of water level at the head of the harbour caused a strong current, which changed its direction every eleven or twelve minutes. The regular reversal of current was indicated in a remarkable manner by the behaviour of the spar buoy moored off Magazine Point. The weather during the morning was normally fine—that is to say, nearly calm inside the harbour, with a light but gradually increasing sea breeze outside.

The similarity in the period of the undulations observed at Sydney and at Malta suggests a common origin.

If, however, as Mr. Russell seems to think, the Sydney waves are due to the combined effect of wind and current influences exerted at a considerable distance, this similarity of period can be little more than a curious coincidence. Long period undulations, such as these under consideration, could hardly be originated by the wind and current systems of the Mediterranean, which, at the given time of the year, at all events, are feeble and comparatively local in their effects.

If, on the other hand, we for a moment suppose that the action of local currents and sea breezes, driving a head of water into the inlet, results in the establishment of regular oscillatory movements, is it probable that the "natural periods" of two harbours, differing so much in area as do those of Sydney and Valetta, would be so nearly equal?

Considerations such as these seem to indicate that the cause of these "short period" tides is one and the same, notwithstanding that they occur on opposite sides of the world and apparently under different conditions; and also that their real origin has not yet been ascertained.

Trustworthy observations in landlocked bays and harbours are still very much wanted, and it may be that until such are available in a greater degree than at present, the whole subject of tidal irregularity will remain more or less obscure.

In conclusion, sir, permit me to express the hope that you will afford space for the discussion of this interesting subject in your columns by those who are able to deal with it. In this way we may hope to ascertain whether any trace of earth movements occurring at short and regular intervals has been noticed near the localities and at the times mentioned; for it is just possible the true cause of these remarkable tides may be one hitherto unsuspected. ANTHONY S. THOMSON.

Concerning the Thermodynamic Correction for an Air Thermometer.

IT seems noteworthy not only that the theoretical investigation on this subject, given in Maxwell's "Theory of Heat" and Tait's "Heat," is fallacious, as has been pointed out by Mr. Rose-Innes in his letter which appeared in your issue of May 26, but that there is no indication in either of these text-books that the result given is not in accordance with the experimental facts. The investigation in question, which is practically the same as that first given by Lord Kelvin before the experiments were performed, leads to the result that the cooling effect should be proportional to the difference of the logarithms of the pressures before and after passing the plug, instead of proportional to the difference of the pressures themselves, as was actually found to be the case; the discrepancy was, of course, noted by the experimenters. The methods used in all the theoretical discussions in Lord Kelvin's papers on this subject prior to the final one in Part iv. of the papers "On the Thermal Effects of Fluids in Motion," seem equally open to objection. The numerical results derived by the last method, which seems perfectly sound, were given apparently for the first time in the article "Heat" in the "Encyclopaedia Britannica"; the investigation and results are reproduced in Preston's "Theory of Heat," and substantially in Parker's "Thermodynamics." The correction obtained to the number representing the temperature of melting ice on the absolute scale by this method was + ·70, the previous methods giving in succession + ·83, − ·03 and + ·87; the uncorrected estimate finally used was also different from that taken at first. W. MCF. ORR.

Royal College of Science, Dublin, November 25.

Science in Elementary Schools.

THE report on the teaching of science in elementary schools, drawn up by the British Association Committee, and published in your issue of November 24, is likely to be unintentionally misleading. The following paragraph leaves out of consideration an important modifying cause:—"It was remarked in the last report that the increased teaching of scientific specific subjects in the higher standards is the natural consequence of the greater attention paid to natural science in the lower part of the schools. The following table shows the correctness of this inference." [Then follows a table showing the gradual increase in the number of children examined in specific subjects.]

The Directory of the Science and Art Department for 1897 contained a new regulation to the effect that "no student may be registered for a grant for day attendance under the Department of Science and Art—except the grants for elementary drawing and manual instruction—whose name is on the register for day attendance under the English or Scotch Education Departments, or the National Board of Education, Ireland." The result of this has been that large classes under the Science and Art Department in such subjects as physiography and hygiene, composed of Standard VII. children in elementary schools, were discontinued; and, possibly with a view to replacing part of the grant thereby lost, specific subjects were taken up in connection with the Education Department. A considerable increase in the number of children taking specific subjects may be anticipated for the years 1897-8 and 1898-9, but the reason will scarcely be that put forward by the British Association Committee, but rather the new regulation from South Kensington. A. T. SIMMONS.

London.

THE new regulation of the Science and Art Department, quoted in Mr. Simmons's letter, was issued only in 1897: it was impossible, therefore, that the effect of it on the day schools could be shown in the tables that form part of our last report. The results may begin to show themselves in the report of next year, but only as an addition to the increase due to the greater attention still being paid to natural science in the lower part of the schools. It is to be hoped that this aggregate increase will be a large one; but it will evidently be very difficult to assign to each cause its proper proportion. J. H. GLADSTONE.

A Remedy for Bookworms.

IN NATURE, No. 1506, vol. lviii., of September 8, there is a review (p. 435) of a book, "Facts about Bookworms," by the Rev. J. F. X. O'Connor, S.J., which concludes by lamenting there is no panacea for these book pests.

Here, in tropical Queensland, I was much troubled by various borers, and "silver-fish"; but for the latter, which apparently only devour the glaze on paper, and paste, I found a new remedy in adding alum to paste, and keeping glazed writing paper in tin boxes.

For the former a solution of *corrosive sublimate and thymol in alcohol*, appears to be an effectual remedy, though probably it would require to be re-applied from time to time; but certainly all books dressed by me with this solution inside and outside the covers, have never been touched since.

The newspaper extract (paper and date unknown), from which I obtained the information, read as follows:—"Surgeon-General Bidie, in the *Fishing Gazette*, recommends a solution of corrosive sublimate and thymol as a perfect protection for books from the ravages of bookworms and other insect pests, having tested it in tropical countries where the termite and the larvae of innumerable creatures batten upon everything eatable, from door-posts to bottle corks."

I have certainly found this remedy thoroughly efficacious, and think it deserves to be more widely known.

J. EWEN DAVIDSON.

Branscombe, Mackay, Queensland, October 20.

The Properties of Liquid Mixtures.

IN the abstract of my communication to the Physical Society in connection with Mr. R. A. Lehfeldt's paper on the above subject (NATURE, December 1, p. 116), the most probable explanation of the fact that, when American petroleum is distilled, the benzene comes over at about 65° instead of 80°, is stated to be that "benzene and hexane behave, as regards distillation, *like miscible liquids*." This should read "*like partially miscible liquids*."

The two liquids are, in fact, miscible in all proportions, and the point is that, in certain respects, they behave as though they were only partially miscible. SYDNEY YOUNG.

December 6.

The Mildness of the Season.

As an instance of the mildness of the season, I may state that on Sunday, November 27, I gathered five ripe strawberries out of my kitchen garden; and that a considerable number of strawberry plants still show signs of flower. Moreover, the leaves of several deciduous trees, such as peaches, lilacs, &c., which are planted in sheltered situations, are still perfectly green; whilst many others are only just beginning to assume their autumn tints. I have also gathered several rosebuds this morning.

In this part of England all the leaves have usually fallen by the end of November. In fact, in ordinary seasons, the elms (which shed their leaves late) are quite leafless by the middle of the month. A. B. BASSET.

Fledborough Hall, Holyport, Berks, November 29.

Iridescent Clouds.

THERE was a fine example of clouds showing iridescence on December 4, from 8.50 to 9.5 a.m., in the south-eastern sky. It occurred on a large white cumulo-maculo cloud, the iridescence being confined to the upper and lower margins, which were much striated.

This was at first the same period *after sunrise* as I have commonly observed the phenomenon to occur *before sunset*, *i.e.* at about an hour's distance from each event (*vide* my letter on the subject, NATURE, vol. lviii., p. 390). I have not seen it before in the morning. E. ARMITAGE.

Dadnor, Herefordshire, December 5.

The Origin of the Aurora Spectrum.

WITH reference to the question as to whether there is any auroral line in the position of the krypton line about 587, the nearest lines to this that have been observed in the aurora appear to be 5765 and 595 observed by Gyllenskiöld. His observations were only rough, but the question is whether they are near enough to the krypton line for either of them to be the same as it. If there is any auroral line about 556, it is likely that the great brilliancy of that at 557 would account for its not having been seen. T. W. BACKHOUSE.

West Hendon House, Sunderland, November 30.

SVEN HEDIN'S "THROUGH ASIA."[1]

CAPTAIN FRANK YOUNGHUSBAND prefaced his charming work on Central Asia "In the Heart of a Continent," by a lament that his early education had been wasted on dead languages, so that he started on his travels ignorant of scientific methods of thought or observation (see NATURE, June 11, 1896). Dr. Sven Hedin has no such fault to find with his upbringing. Trained in physical geography in the University of Berlin under the great Asiatic traveller Baron von Richthofen, he chose the least-known parts of Asia as a field for exploration, and fitted himself as an explorer by years of preliminary study and Eastern travel. Few men, especially in this country, attracted instinctively to the studies which can make them geographers, have had the opportunity of becoming travellers, although many travellers have been stimulated by their experiences to take up the study of geography. Dr. Hedin writes, as he travelled, like an accomplished geographer. He was no sportsman; and, although a sedulous collector, he was neither botanist, zoologist nor geologist, possessing only that sympathetic general knowledge of natural science which is essential to a geographer, and invaluable to a traveller as a guide to observation. He not only qualified himself in practical astronomy and surveying, so as to collect trustworthy material for maps, but took special pains to master all necessary languages. Besides his native Swedish he was proficient in German, French, Russian and English, and could thus converse easily with every European traveller and official he met; he had already learned Turki, so that in western Central Asia he could question the natives directly, and in the course of the journey he acquired sufficient facility in the use of Mongol and Chinese to enable him to dispense with interpreters.

Being a translation, though a good one, "Through Asia" cannot be compared in style with the best English books of travel; but in substance it is so full, solid and interesting that this is soon forgotten. An awkward phrase, indeed, puzzles one occasionally, such as "diopters" (which may mean the sights for a plane-table); "temporal observations," instead of "observations for time"; and a few others. The word "glen" is very frequently used in a sense which appears to be the same as valley, but may contain some undesignated shade of difference.

King Oscar, whose interest in travel and in all matters Oriental is well known, interested himself in the proposed journey, and assisted in supplying the very modest funds (1900*l.*) required for what has turned out to be one of the cheapest, as well as one of the best, of the great journeys of the century.

Dr. Hedin travelled altogether 14,600 miles, of which 2020 had never before been traversed by a European. He made a continuous map of his route for 6520 miles, which is now being worked up in the great cartographical establishment of Perthes in Gotha, and innumerable observations on the volume of rivers, the depths of lakes and the temperature of air, water and soil, which will all be discussed and published separately. His collections of natural history specimens and archaeological remains will also be made the subject of monographs. Thus although the mass of the scientific data obtained is large, but little of it is considered in this book, which is a compressed narrative of the whole three years' journey, containing, indeed, a fair amount of adventure quietly told, and just enough of the more technical aspect of geography to enable the general reader to understand the explorer's motives and appreciate his results. Enough is stated, however, to show that it is the record of one of the finest scientific journeys ever carried out in trackless Asia.

[1] "Through Asia," by Sven Hedin. With nearly three hundred illustrations from sketches and photographs by the author. Two vols. Pp. xx + 1278. (London: Methuen and Co., 1898)

Dr. Hedin's work was divided into several expeditions, between which he rested for a few months at a time at Kashgar and other Asiatic cities. The first journey, after driving across the Kirghiz steppe round the north of Lake Aral to Tashkent, was the crossing of the Pamirs in the winter of 1893 by a road traversed in the open season by the Russian garrison of Fort Pamir, and kept open for their mails all the year. The most interesting incident of this journey was the sounding of the great Kara Kul by means of holes cut in the ice. The lake is without outlet and salt, with an area approaching 150 square miles, and the elevation of its surface above sea-level is 13,000 feet; it is completely surrounded by lofty mountains. The lake is divided by a low peninsula into two basins; the eastern, in which three soundings were made, varied from 41 to 63 feet in depth, with a temperature of from 34°·2 to 35°·2 at the bottom, and the ice was from 3 feet to 3 feet 6 inches thick. The western basin was tested by four soundings, of which the shallowest was 256 feet with a bottom temperature of 35°·8, and the deepest 756 feet with a bottom temperature of 38°·3. The thickness of the ice here was only from 1 foot 4 inches to 1 foot 9 inches; and the temperature of the air was −20° F. at night. The depth, although considerable, should hardly, however, be called "abysmal," even for a lake.

The second piece of work undertaken was the study of the great snow-clad mountain Mustagh-ata, which is the loftiest summit of the Pamirs, towering to 25,600 feet. Dr. Hedin ascended its slopes to the height of 20,660 feet, where he passed the night. To this elevation he was able to ride on a yak, and bring up his whole camp equipment; so that a trained mountaineer to whom it is a pleasure to climb higher than other people, should here have a good opportunity for making a "record" climb from a comfortable base. Dr. Hedin, however, was not a mountaineer, and defeated in the attempt to climb, he made a careful study of the glaciers all round the mountain. The snow-field of Mustagh-ata measures roughly 10 miles by 6, and from the snow-line valleys radiate in all directions, many of them occupied by great glaciers, the streams from which are collected in rivers on the plain, which flow round the base of the mountain for three-quarters of its circumference before they turn finally to north and south. The work on Mustagh-ata occupied, with occasional intervals, the time from April to October 1894, and during much of this time Dr. Hedin lived amongst the Kirghiz as one of themselves, and obtained a great deal of information as to their customs and mode of life. The winter was spent in Kashgar, where Mr. and Mrs Littledale happened to be staying at the time, preparing for their great journey across Tibet from north to south.

In February 1895, Dr. Hedin set out on his most adventurous journey, in which he barely escaped with his life, in the desert of Takla-makan. Crossing the Yarkand-daria at 39° E., the desert was crossed in a more or less easterly direction. The party had eight camels, of which only one survived; and the guide with another man, who were believed to have treacherously taken a smaller supply of water than was ordered, perished of thirst in the sand, possibly through being unable to desert so soon as they had planned. Fifteen days were expected to suffice to reach the Khotan-daria, but twenty-six were required. During the greater part of this time the scenery was one monotonous waste of yellow sand dunes, the surface unvaried by a vestige of vegetation, or even by a stone. The largest dunes were as much as 200 feet in height with a crescentic ground plan, and exceedingly steep on the leeward slopes. It was impossible to follow a straight course, and as the intermediate low ground was often occupied by "pools" of the finest sand, in which the camels sunk deeply, it was often necessary to wind over the slopes, following the crests of successive dunes. No living thing was to be seen. When at last Hedin emerged from the sand, and struck the Khotan-daria, he was alone, on foot, and in rags. By carrying back a supply of water in his boots he saved one of his men; two others with one camel also escaped, and brought some of the instruments and all the note-books; so that what at one time appeared likely to be irretrievable disaster was averted, but narrowly, as he was a week without food. The river was followed northward to Aksu, and Kashgar re-entered on June 21. While waiting for the new instruments, which had been telegraphed for to Europe, Dr. Hedin took another run to the Pamirs, a sort of pleasure trip, for he had the good fortune to share in the festivities of the Anglo-Russian Boundary Commission.

In December 1895 he left Kashgar finally for further explorations in the desert, travelled to Khotan through Yarkand, and along the southern margin of the desert, and collected so much material that he proposes to make another book of it. The *kara-buran*, or black sand-storm, which is common in that region at certain seasons, seems to be similar to the American tornado. This type of storm occurs only in summer, and almost always in the afternoon, rarely lasts above an hour, comes more frequently from the west than from the east, and is so furious in its intensity as to sweep sheep away bodily. Another strip of the desert was crossed from the Khotan-daria to the Keriya-daria, a river never before visited by a European; and on the way Dr. Hedin discovered the ruins of an ancient city, called Takla-makan, built of wood, and full of relics of an ancient time, when the prevailing religion was Buddhism. The curious appearance of the ruins as they project from the sea of dunes is well brought out in the illustration on the next page. These dunes have a uniform angle of 33° with the horizon on the steep leeward slope, while the windward slope varies from 20° to as little as 1°; a calculation gave about 160 feet per annum as their average rate of advance. The grassy borders of the Keriya-daria were found inhabited by a race of shy shepherds, who rarely visit a town, and had never seen a European before. The desert margins abounded in wild camels, several of which were shot. From all Dr. Hedin could see and hear of them he was convinced that they are descendants of the tame camel, their present wild life being a reversion to nature, not a primitive state.

Proceeding northwards, the Tarim river was crossed on the ice in February; this river, in the latitude of Naples, is said to remain frozen for three months of the year, a good example of the effect of continental climate, although the atmosphere is too dry to furnish any snowfall.

The Lop-nor region was made the object of careful study, and geographically this is one of the most interesting parts of the whole book. A controversy as to the character of Lop-nor has been going on for many years. The great Russian explorer Przhevalsky explored a lake which he held to be the ancient Lop-nor; but it was fresh, yet without outlet, which proves that it must be of very recent formation. Richthofen pointed out that the ancient Lop-nor, placed by Chinese geographers a degree further north, must be salt if it still exists; but Hedin discovered that there is a very recent lake which he believes reoccupies the western part of the bed of the old Lop-nor, which has been nearly filled up by desert sand. The whole region is almost at the same level, and the lakes are so thickly overgrown with huge reeds, that it is very difficult to trace the boundaries of the shallow sheets of water, which evidently shift in position from time to time as the rivers of the desert also do. The Lop-men are very expert canoists; but the translation is obviously in error in speaking of them as "rowing" the long narrow canoes with "oars," which would be impossible without outriggers; the illustrations show them paddling by means of paddles, a very different method of propulsion.

The last piece of exploration recorded in the book has

redeemed a long strip of the map of Tibet along the parallel of 36° N. from absolute blankness. Leaving Khotan with a large caravan of horses, donkeys and camels in June 1896, Dr. Hedin proceeded eastward, skirting the desert to Kopa, then turning south-west into unknown country across the west end of the Altyn-tagh, he crossed the parallel range of the Arka-tagh (close to the place where Littledale crossed it going south), and marched eastward for twenty-six days along a great elevated region averaging nearly 16,000 feet in height, with the Arka-tagh bordering it to the north, and another snowy range, the Kokoshili, to the south. This is spoken of as a "latitudinal valley," or as a valley bordered by "latitudinal mountain ranges," but the sense of the term is not clear, the expression *longitudinal valley* would appear to be the correct one, as it seems to be a vast trough between parallel mountain ridges. The centre of the trough is occupied by a succession of small basins, each an independent centre of drainage, and each containing a long narrow salt lake lying east and west. It is really a land-surface in the making. If the precipitation had been heavy enough to fill these basins and start rivers flowing from one to another, the whole valley would now be drained by a great axial river; but in default of river erosion the basins remain untapped, and wind and frost alone are fashioning their peculiar topography. A little yellow grass was found in patches in the basins, on which vast herds of wild asses and wild yaks were feeding; but for fifty-five days no human being or human habitation was seen. We look forward with much interest to the detailed description of this interesting region, the map of which, prepared in Sweden, is obviously only provisional, and not accurate; for instance, the distance between camps xxii. and xxiii., said in the text to be the longest day's journey, is represented as very nearly the shortest, and the position assigned to the camps does not fit the description. At length, on October 1, 1896, Mongols were met, and a descent made from the Tibet plateau to the Tsaidam swamps, whence the route lay over known ground to Peking, and thence Dr. Hedin returned to Sweden across Mongolia, Siberia and Russia.

When one contemplates such a journey, so brightly and popularly told, full of adventure, hardships and solitude, yet every hour of it occupied in collecting, observing, note-taking and map-making, and when one remembers that only German training can make such work possible at present, even to the most adventurous and persevering traveller, it is impossible not to be struck from another side by Sir John Murray's feeling, expressed in his recent appeal for Antarctic exploration:—

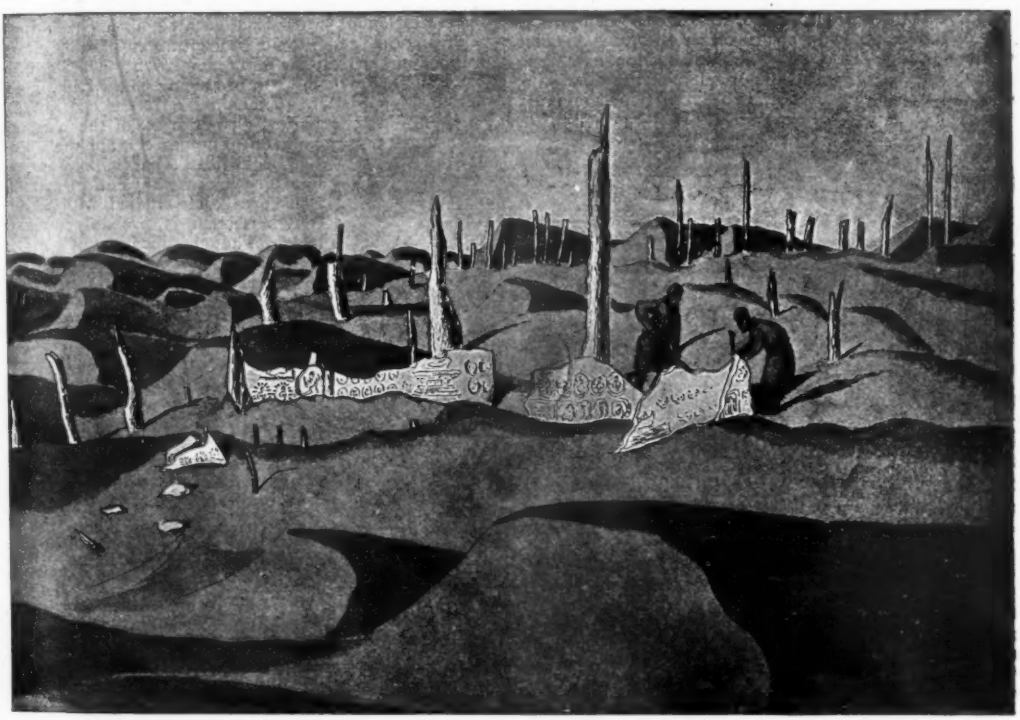

FIG. 1.—The ruins of Takla-makan east of the Keriya-daria.

"The conviction that we are, in exploration and scientific research, not doing anything like our best, is much deepened when we compare our present efforts with what is being done in these directions by other progressive nations." HUGH ROBERT MILL.

THE AMERICAN AGRICULTURAL YEAR-BOOK.[1]

YEAR by year the official volume issued by the Department of Agriculture at Washington appears to increase in interest and importance, and the latest addition to the series is well-nigh bewildering in the

1 "Year-book of the United States Department of Agriculture, 1897." Pp. 492; with 40 plain or coloured plates, and 45 figures in the text. (Washington: Government Printing Office, 1898.)

scope and variety of its contents. Making every allowance for the fact that the functions of the United States Minister of Agriculture extend over an area practically as large as that of Europe, and for the circumstance that much of the agricultural practice of the western hemisphere is still in the tentative stage, the volume is nevertheless impressive on account of its encyclopaedic character. Precedence is given to the annual report of the Secretary, who is the political head of the Department, his position being comparable with that of the President of the Board of Agriculture in Great Britain. This document, of which a preliminary issue was made at the close of last year, occupies 50 pages, and deals comprehensively with the whole work of the Department. A section of 220 pages is next taken up by articles, nineteen in number, written by the heads of the several divisions of the Department, and setting forth the relation of the work of each division to the farming industry. This, we may remark, is a special feature of the current volume, and is the outcome of an express wish on the part of the Secretary, who took over the reins of office for the first time last year. The third section, extending to 340 pages, is one with which readers of the Year-book are familiar, as it has been a feature of previous volumes.

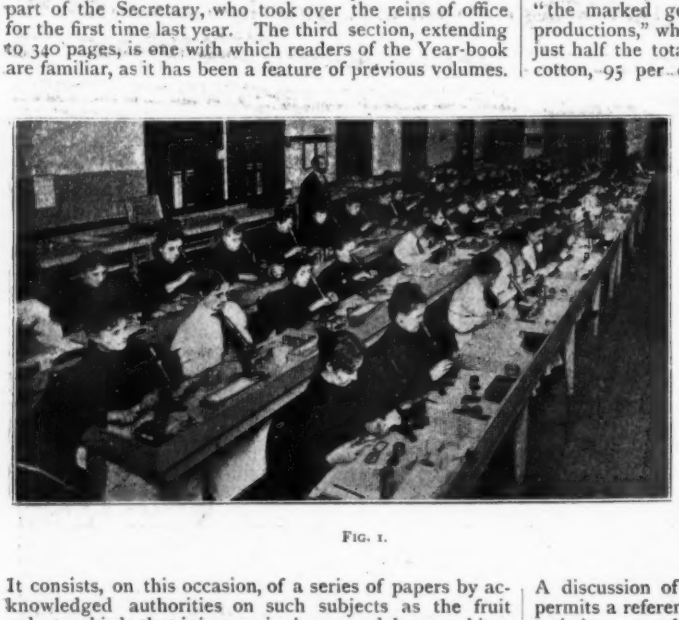

FIG. 1.

It consists, on this occasion, of a series of papers by acknowledged authorities on such subjects as the fruit ndustry, birds that injure grain, lawns and lawn-making, utilisation of hybrids in plant-breeding, soil problems, seed testing, leguminous forage crops, danger of importing insect pests, and the utilisation of by-products of the dairy. An appendix of 140 pages is well filled with a variety of useful matter, mainly statistical; but we do not observe at p. 714, where the area under wheat in 1897 is given as 39,465,066 acres, any reference to the fact that this represents a deviation of nearly 5,000,000 acres form the true extent of surface thus occupied, the underestimate being apparently the result of an accumulation of errors for a series of years. Lastly, the volume is furnished with an admirable index of 32 pages, which adds greatly to its value as a work of reference.

A few examples, selected at hazard from different parts of the year-book, will serve to indicate the nature and value of the information which it conveys. Attention has been bestowed upon the investigation of certain crops, the produce of which is largely imported, but which could probably be grown with profit in the United States. Chicory is a case in point; the whole of this material required for consumption has hitherto been imported, but it is believed that in the course of ten years the country will be growing enough to entirely meet the home demand. Ten years ago the United States imported annually about 130,000 dollars' worth of insect powder, but the experimental cultivation of pyrethrum in California proved a success, the result being that the import trade referred to has dwindled away. The loss in the United States from the diseases affecting cereal crops is estimated to amount to 25,000,000 dollars or 30,000,000 dollars annually. Cotton, tobacco, potatoes and other staple crops are correspondingly damaged. In one year the loss arising from diseases of orange, lemon and other citrus fruits was estimated at more than 450,000 dollars in Florida alone. From plant-diseases of all kinds the loss to the entire country is put at 150,000,000 dollars to 200,000,000 dollars annually. Against such calamities the work in the division of vegetable pathology is making steady progress, and significant examples are given of the benefit that has thus already accrued to the grape-grower, the nurseryman and the orchardist. The diversification of crops is advocated as a check upon "the marked geographic concentration of agricultural productions," which has resulted in twenty-five States, or just half the total number, producing 98 per cent. of the cotton, 95 per cent. of the maize, 95 per cent. of the barley, 93 per cent. of the oats, and from 80 to 90 per cent. of the wheat, rye, buckwheat, tobacco, potatoes and hay grown in the entire country. Soils are being studied with a thoroughness that is probably unparalleled. The classification of soils on a geological basis, their texture, their structure, and their relation to water, are receiving the fullest attention. With regard to the cause of the movement of water in soils, "it was understood that it was the contractile power of the film of water around the soil grains that caused the movement of water to the plant. It appears now, from a minute study of this problem, that the movement is dependent upon the curvature of this film rather than upon the total area of its surface." Many an English traveller on the western prairies has been struck by the seemingly harsh and innutritious herbage upon which cattle and horses nevertheless live and thrive. A discussion of the value as forage of so-called weeds permits a reference to various plants which are drought-resisting, or thrive on alkali lands, and are valuable as forage. They include white sage (*Artemisia* spp.), green sage (*Bigelovia* spp.), sweet sage or winter fat (*Eurotia lanata*), salt sage (*Atriplex* spp.), and grease wood (*Sarcobatus vermiculatus*). It is probable that these could be profitably grown under cultivation, and thus made to yield a much larger amount of forage than is now obtained. The contention that every farm is an experiment station cannot be controverted, and it would be advantageous to farmers in all countries were they more habituated to the regular use of the note-book. The cultivation of catch crops to maintain a supply of nitrogen in the soil, is a headline that cannot fail to attract the eye of English agriculturists. If catch-cropping is understood and intelligently practised anywhere, it is on the light arable lands of England, where the system may almost be said to have originated —at a time, moreover, when practice was in advance of science, for farmers had approved and adopted the system before the extension of our knowledge of the nitrogen problem had supplied the theoretical justification. The work of the chemical division with regard to the development of cane and beet, and other sugar-producing crops,

has been fruitful in result. In the course of experimental work occupying eight years, the percentage of sugar in field crops of sorghum was raised from 9 to 14. The investigations concerned with beet cultivation have been so successful that the establishment of an indigenous sugar industry is now certain, and the benefit to American agriculture in the near future will be measured by hundreds of millions of dollars.

It would be instructive to refer to the work of the Weather Bureau, and of the divisions of entomology, agrostology and forestry; but it must suffice to conclude with a few observations on the bureau of animal industry.

Those who have been engaged in recent years in the administration of the Diseases of Animals Acts in Great Britain will best appreciate the comprehensiveness and the excellence of the work of the Washington Bureau. It is a bold statement to make, perhaps, that the whole of the United States territory—from the Atlantic to the Pacific, and from the great lakes to the Gulf of Mexico—has been swept free from pleuro-pneumonia; and those who are familiar with the history of this most troublesome disease in Great Britain will only hope that the assertion may prove to be true.

The microscopic inspection of pork intended for export is worthy of all praise, and we reproduce an illustration showing this work in progress. Last year 1,881,309 specimens were thus examined for trichinae, and only 13,325 were found infested; the cost of this inspection was 111,670 dollars.

EDWIN DUNKIN, F.R.S.

AT the ripe age of seventy-seven, with the consciousness of having fulfilled a useful career, and amid the respect and sympathy of his associates, Mr. Edwin Dunkin has passed away, again diminishing the small band of zealous assistants, that Sir George Airy collected around himself, when some sixty years ago he undertook the reorganisation of the Royal Observatory, and inaugurated that system of uniform and continual observation which has ever since remained the chief characteristic of that institution. To trace the career of Mr. Edwin Dunkin is to recall the history of the Observatory under its late director, for during nearly half a century Mr. Dunkin took a prominent part in its activity, filling many responsible positions, till finally he became the chief and confidential assistant. In whatever capacity he was placed he was admirably adapted to it by reason of his painstaking and accurate observation, his loyalty to his chief, and his keen interest in the science. It was his fortune to see and to assist in the creation and development of a magnetical and meteorological department, to witness the establishment of a system of extra meridional observations of the moon, to see the observations of Right Ascension and Zenith Distance effected by a single instrument, and to mark the substitution of chronographic registrations for the older method of recording transits. He remained at his post long enough to note the introduction of the spectroscope and of photographic processes: in a word, to form a link between the methods of the old astronomy of position and the purposes of the newer physical science. He lived to see the staff of the Observatory trebled and quadrupled, as fresh objects of inquiry were brought within its scope; and that he could adapt himself to every change, and lend his experience to ensure the smooth working of the ever-growing machinery, is to say that he was an able and useful official, rendering good work in his day and generation.

Naturally, from his official position, Mr. Dunkin took part in many of the scientific expeditions organised at the Royal Observatory under Government auspices. Among the earliest of these was a visit to Christiania to observe the total eclipse of the sun in 1852. The instrumental equipment provided, consisted of a telescope of 3½ inches aperture, mounted on a firm tripod, and provided with steadying rods. If this optical assistance appears to us now antiquated and inadequate, the observations made with it read even more strangely. We may quote one sentence from the official report, which illustrates the progress of physical inquiry accomplished within a single scientific life. Mr. Dunkin is describing his first impressions of a solar prominence:

"My eye was intently fixed upon it for about a minute of time, and during that interval not the slightest change took place in its form. Its colour was pink, or rose colour, but the shade was not very deep. It seemed to me at the time, from the excessive steadiness of this prominence, and from the fact that I had zealously watched it for so long an interval without its undergoing any change, that this object had some connection with the *moon*. However . . . it is possible I may be deceived."

Another classical experiment in which he was engaged, and to whose minute care the measure of success obtained was mainly due, had reference to the determination of gravity at different distances below the earth's surface, by means of pendulum experiments. Some thirty years previously, the late Astronomer Royal had carried out an investigation of the same nature, which had not led to a satisfactory termination; but in the case of the Harton Colliery, where experiments could be effectively made at a depth of 1260 feet, Sir George Airy expressed himself as quite satisfied with the result achieved, and considered that it established a favourable precedent for similar inquiries in the future. The result was to show an increase in the force of gravity of 1/19000 at the depth reached. Longitude determinations may be said to come almost within the daily routine of the Royal Observatory, and it would not be necessary to refer to the share Mr. Dunkin took in these, but for the fact that the system of telegraphic signals was a new and practically an untried method when Mr. Dunkin and M. Faye were engaged in the longitude determination of Paris. Doubtless there were difficulties in those days, which have been so effectually overcome that they have been forgotten; but as a pioneer, Mr. Dunkin, and those who were associated with him, must have exhibited a manipulative skill which we may now fail to appreciate.

We should do less than justice to Mr. Dunkin's memory if we did not recall his long and eminent services to the Royal Astronomical Society, which he served in various capacities. He was Secretary at the time of the removal of the Society's property from Somerset House to its present quarters, and the reorganisation of the library, and the restoration of order into the Society's affairs, which had fallen a little out of gear, devolved mainly upon him, but his methodical habits and unstinted devotion to the interests of the Society ensured complete success in the regularity and management. Among other services to the Society, one may mention the many obituary notices which it was his misfortune to have to write, but which were always recognised as just and appreciative, and not without literary merit. His scientific communications had generally some reference to points of importance in practical astronomy, such as the treatment of personal equation in observations, or the determination of proper motions of stars. He was eminently a practical astronomer, rendering useful, if less brilliant work than the mathematician; but the many solitary hours he passed at the eye-piece of the transit circle, or the altazimuth, will not be without their due effect in advancing the interests of astronomical science.

W. E. P.

NOTES.

WE are informed that the Government is prepared to make the financial arrangements necessary to enable the Imperial Institute to become the headquarters of the Organisation of the New University of London. This decision of the Government was brought before the Senate at its meeting yesterday by the Vice-Chancellor, and it is hoped that no unnecessary delay will occur in securing the agreement of all parties concerned. While it is doubtful whether a Faculty of Commerce commensurate with the other Faculties can be at once established, it is most important that the various subjects which would naturally be included in it should be taught. This teaching might fairly find a place in the Imperial Institute under the authority and control of the New University. Some of the instruction would be germane to the valuable collections of raw materials, &c., in the Institute.

A VERY considerable discussion of an informal character is now going on among many interested in the various institutions which may form part of the new University. It is to be deplored that there is a great probability of the work of the Commission being hampered by the fact that many of the suggestions now being made are more inspired by the local interests concerned than by the desire to help on the educational question in the abstract. We use the word abstract in no pedantic sense, and with a full appreciation of the concrete questions involved. The Commission has to deal with an area defined by a radius of thirty miles, a population which we may roughly estimate at seven millions, and a large number of existing institutions. The amount of good the Commission will ultimately produce along new lines will, we take it, be capable of measurement by the success it will achieve in coordinating the old forces which are already at work, by working on the principle of organic growth and regarding what exists from the most general standpoint. It is from this point of view that we deprecate some of the suggestions now being made, because, if accepted, they will harm existing institutions, because the new University must not commence by localising itself, however high any local bid may be, and because again no good work will be achieved if any new suggestions be accepted before the actual condition is fairly grappled with, mastered and legislated for.

THE President and Council of the Geological Society will be "at home" to the Fellows on Friday, December 16.

THE *Pioneer Mail* states that the Nizam's Government has sanctioned the immediate construction of a complete and thoroughly equipped Pasteur Institute for Hyderabad. It will adjoin the hospital and medical school, and will be available in about six months for patients.

IN the forthcoming session of Congress, the Hurley Bill, providing for the adoption of the metric system of weights and measures in the United States and its compulsory use in all Government transactions except the completion of surveys of the public lands, will be again brought up. The Bill was defeated by only three votes in the fifty-fourth Congress, and the increased interest since given to the subject will, it is hoped, lead to the adoption of the measure.

A FEW particulars with reference to the discovery of a new system of incandescent electric light, by Prof. Nernst, of Göttingen, are given in *Science*. The light requires neither vacuum nor tender filaments. The essential point of the invention is that when magnesia is heated above 3000° C. (a temperature far above the melting point of platinum), it becomes a good conductor, and a very weak current is sufficient to keep it in an intensely luminous condition. Either direct or alternating currents may be employed, and the magnesia is little injured by use. The preliminary heating Prof. Nernst accomplishes by placing the magnesia in the focus of a reflector. On the inner side of the reflector is a spiral wire of platinum, which when brought to incandescence by a current, produces heat sufficient to render the magnesia a conductor; a current is then passed directly through the oxide by the wire, and that in the spiral is shut off. As advantages over the ordinary incandescent lamps Prof. Nernst claims that the same amount of light can be furnished at one-third the cost, and as the magnesia allows of being heated to a much higher degree than a carbon filament a purer light is obtained. The successful employment of a cheaper substitute for the platinum is also announced, though the name is not made public.

PROF. GEORGE FORBES, F.R.S., referred to the utilisation of the Nile cataracts, in his recent lecture at the Society of Arts on long distance transmission of electric power. He remarked as follows:—"My report on this subject is in the hands of the Egyptian Government, and is their property; but I am not divulging secrets when I tell you that the electric lighting of Cairo could be done cheaper by power generated at the First Cataract than by steam engines at Cairo. The distance is 400 miles as the crow flies. Do not imagine that I propose lighting Cairo immediately in this way. The Government has far more important uses for the power, not only in the irrigation of the country as it is, but still more for the perennial irrigation which will be so much extended when the great reservoir designed by Mr. Willcocks, Sir William Garstin, and Sir Benjamin Baker shall be completed by Mr. John Aird. You may take it as certain that before long the cataracts will be harnessed and forced to assist in developing not only Egypt proper but the Sudan, and especially the Dongola province up to the Fourth Cataract, which, with efficient irrigation, may become the most fertile country in the world."

AFTER several visits to the Orkneys, Prof. Newton succeeded this summer in landing upon the Holm of Papa Westray, a small island lying to the eastward of the larger one, from which it is separated by a comparatively narrow and shallow sound. A survey of Papa Westray in 1888 led Mr. Buckley to believe that he had found the last breeding place—reputed to be thereon—of the Great Auk or Garefowl (*Alca impennis*). The unsuitableness of any part of the island as a breeding place for such a bird was afterwards pointed out; but an examination of the Holm of Papa Westray led to the discovery of a locality adapted in every way to the habits of the Garefowl, and Prof. Newton considers that there is no room for doubt that the Holm was the true home of the species whose extirpation, so far as Orkney is concerned, was compassed in 1813. In connection with this subject it is interesting to mention that Mr. Symington Grieve contributes to the *Transactions* of the Edinburgh Field Naturalists' and Microscopical Society some additional notes on the Garefowl, with special reference to two newly-recorded skins. He states that the existing remains may now be summarised as follows:—Skins, 80-82; skeletons, more or less complete, 23-24; detached bones, 862-874; physiological preparations, 2-3; eggs, 71-72.

THE weather reports issued by the Meteorological Office show that during the month of November the rainfall in different localities has been considerably influenced by the tracks of the storms, some of which have passed to the north and others to the south. Generally speaking, the rainfall has been excessive in the north-west and south-west of our islands, and deficient in the eastern parts. But not unfrequently stations not very far apart have received very different amounts of rainfall. At

Stornoway (Hebrides) the fall was about double the average, the excess being 5 inches; while at Sumburgh Head (Shetlands) there was a deficiency of 0·27 inch. At North Shields there was an excess of 0·95 inch above the mean for the month, while at Leith there was a small deficiency. The following values above or below the monthly mean are noteworthy:—Valencia, + 1·26 inch; Roches Point, −0·96 inch; Hurst Castle, +1·25 inch; Dungeness, −1·83 inch; Holyhead, + 0·08 inch; and Liverpool, −1·12 inch. Generally speaking, the rainfall since the beginning of the year is still considerably deficient, except in the north of Scotland, where the excess is above 9 inches.

AT the meeting of the French Meteorological Society on November 3, under the presidency of M. Poincaré, M. Teisserenc de Bort presented the first part of a very important work by Dr. Hildebrandsson and himself, entitled "Les bases de la météorologie dynamique. Historique, état de nos connaissances." This part contains the history of all the ancient researches from the time of Aristotle to the present date. In the second part, now in the press, the history will be continued, and will be followed by theoretical questions, such as the distribution of aqueous vapour in the atmosphere, and that of the meteorological elements over the surface of the globe. A paper by M. Coeur de Vache was read on the atmospheric electricity of the months of March 1886-1895, or during a period of 213 days. This investigation shows that the diurnal oscillation of atmospheric electricity depends especially upon the humidity of the air, both with regard to its amplitude and to the normal hourly values. The other papers read related to the unmanned balloon ascents of October 3 last, by M. Teisserenc de Bort, and to the action of the moon on the movements of the atmosphere, by M. Poincaré.

WE have received a copy of "Observations and Researches" made at the Hong Kong Observatory during the year 1897, under the superintendence of Dr. W. Doberck, the director. In addition to the usual observations and results of the meteorological and magnetic instruments, the report contains detailed information upon the other valuable work carried on at the observatory. For the daily weather forecasts a complete success of 65 per cent., and a partial success of 31 per cent., are claimed. Following the method used in some other meteorological establishments, and adding together the sum of total and partial success, the high figure of 96 per cent. is obtained. During the year 1897, besides the meteorological registers kept at forty stations on shore, the log-books of 283 vessels have been copied, for use in the construction of trustworthy pilot charts of the Eastern seas. The report also contains the third edition of the law of storms in the Far East, to which we briefly alluded in our issue of October 20. Dr. Doberck is very sanguine about the results of this investigation, and states that the typhoons, about which little was known when the observatory was built, in 1883, are now among the best understood atmospheric disturbances. A chart is given showing the average tracks of these storms.

THE question of the porosity of thin steel plates under heavy hydraulic pressure having been raised (says *Engineering*), experiments have been carried out at the Washington Navy Yard with the view of settling the point in a practical way. Pieces of sheet steel of ¼ inch, ⅛ inch, $\frac{1}{16}$ inch, and $\frac{1}{32}$ inch in thickness were subjected to a water pressure of 6000 lb. per square inch, and in no case was any percolation found. A ¾ inch rivet joining two ½-inch plates also proved tight under the same pressure. A test was also made to determine the friction of water under high pressure, and, while it was inconclusive, there was no evidence that the friction of water under high pressure was any greater than the friction of water not under pressure.

AMONG the methods of reducing a compressed gas to a lower pressure by irreversible transformations, those of Joule's well-known experiment of expansion into a vacuum, and Lord Kelvin's experiment of expansion through a porous plug are the most important, and the recent applications of the Kelvin effect to the liquefaction of gases has added fresh interest to the latter. An investigation of the thermodynamics of the process in question is given by M. A. Witkowski in the *Bulletin* of the Cracow Academy, pp. 282–295. These observations support the view that beyond certain limits of temperature and pressure, expansion of a gas is accompanied by heating instead of cooling, and the author investigates the temperature of reversal for air and for hydrogen. The conclusions tend to show that in liquefying gases by expansion there is no advantage in making the initial pressure too great; a pressure of 200 atmospheres, as employed in Linde's machine, being amply sufficient. The cooling resulting from expansion into a vacuum is rather greater than would be obtained for the same pressures in the Kelvin-Joule apparatus.

THE study of hydrodynamics has been greatly facilitated by the series of reports which have been from time to time brought out dealing with the progress made in the subject during various periods. These include Sir G. G. Stokes' report to the British Association of 1846, Prof. Hicks' reports of 1881–82, Mr. Love's paper on Vortex Motion in the *Mathematische Annalen* for 1887, Prof. Hicks' account of the same subject in his sectional address to the British Association at Ipswich in 1895, and Prof. Darwin's Encyclopaedia article of 1888, on Tides. In *Science* for November 11, Prof. Ernest W. Brown, F.R.S., gives an interesting account of recent progress towards the solution of problems in hydrodynamics which have not been included in these previous reports. The author deals at considerable length with wave motion, viscosity, and two-dimensional discontinuous motion, pointing out that no case of three-dimensional discontinuous motion has been solved. In connection with viscosity Prof. Brown remarks that "in all problems hitherto solved, only the first powers of the velocities are taken into consideration." But a paper was published by Mr. Whitehead, in the *Quarterly Journal of Mathematics* (vol. xxiii. p. 78), dealing with second approximations to viscous motion, notably for the fluid surrounding a rotating sphere; and the conclusions arrived at seem rather to cast doubts on the validity of the ordinary first approximations. As Mr. Whitehead's paper seems little known, the present reference may save some mathematician the trouble of solving the same problem (as did the writer of the present note), and then finding that he has been anticipated.

A RECENT number of the *Revue Scientifique* contains the continuation of an article by M. P. L. Simond on the transmission of plague-virus. It is now well recognised that rats not only herald the advent of plague, but are themselves largely responsible as direct disseminators of the morbific material; but, as M. Simond points out, they do not account for all the subtle means by which the virus finds its way to the human subject. Further careful researches now show that parasites in the shape of fleas are extremely dangerous disseminators of plague-bacilli. Suspicion fell on these vermin, inasmuch as it is far easier to infect an animal with plague by subcutaneous inoculation than it is through the alimentary canal. A large number of experiments have been carried out by M. Simond to test the validity of his hypothesis, and just as Yersin showed that flies could transmit virulent plague-bacilli, so Simond has found that fleas taken from plague-stricken rats can communicate the disease to healthy animals, vermin from such sources containing in their excreta the virulent plague microbes. We have long known that dirt and plague go hand in hand, and M. Simond's instructive researches furnish yet another proof of the cardinal

importance of combating the disease by unremitting attention to sanitary conditions.

MR. C. S. STANFORD WEBSTER calls attention, in the *Chemical News*, to a novel production of vortex motion. He states that when the freshly gathered leaves of the native Eucalyptus tree (*Eucalyptus globulus*) are ignited, they project vortex rings in considerable numbers in succession, accompanied by a spluttering noise. The best results are obtained by holding the scythe-shaped leaf vertically and igniting the apex—this being the part where the greatest number of translations are obtained. Mr. Webster thinks that possibly in the production of these vortex rings, blisters are first formed by the extrusion of the cuticular tissues, and, on the blisters bursting, air or aqueous vapour is spontaneously liberated, the rings being rendered visible on their contact with the smoke from the burning external portion of the leaf. The leaves of the small English variety of Eucalyptus possess similar properties to the native product, but in a lesser degree, the rings projected being insignificant in size, comparatively speaking.

WE have received a letter from Mr. Charles W. Purnell, of Canterbury, New Zealand, criticising two of the statements made by Prof. Lloyd Morgan in his notice of Prof. Thorndike's experimental study of animal intelligence (NATURE, July 14). Prof. Purnell sees no reason for denying to animals either "conscious [*i.e.* volitional or purposive] imitation," or "memory as involving true localisation in time and space." The facts adduced by Mr. Purnell, however, are not likely to be denied by Prof. Lloyd Morgan or by any careful observer of animal behaviour. The questions he raises seem entirely to turn on the definition of terms, for a discussion of which we cannot afford space.

THE anthropological part of the *Journal* of the Asiatic Society of Bengal (vol. lxvii.) contains six papers, all of value. The taboo of names amongst the Santals is examined most carefully by Mr. P. O. Bodding, and his explanation of it seems convincing. Taking it in conjunction with other taboos, it seems to be a series of rules for defining and keeping intact the standard of conduct among the members of the tribal family, and it is well to note the scarcely veiled system of polyandry which obtains with regard to the wife of the family chief and his brothers. If this is the survival of an older social stratum, while the taboo existing between the family chief and the wives of his younger brothers marks the rise of a newer order of things, it seems that we have here a most interesting phase of social evolution. The Santals are divided into twelve totemistic septs, and Mr. Bodding also examines the taboos connected with this cult; and in another paper the same author deals with the salutations used by the Santals in a manner to show their bearing upon tribal society. The rain ceremony from the district of Murshidabad, Bengal, by Mr. C. C. Mitra, is highly instructive, especially as the author shows its close connection with Lithuanian and other European customs of modern times. By the same author is a paper on the lizard in Indian superstition and folk-lore. Mr. E. A. Gait's paper on human sacrifice in ancient Assam is a useful description of this practice according to the tribes among whom it obtains.

THE *Bulletin* (vol. ii. No. 2) of the Madras Government Museum, by Mr. Edgar Thurston, shows how useful has been the work begun by Mr. Risley. The physical measurement and other particulars of the Eurasians of Madras and Malabar, accompanied by excellent photographs, are taken from a sufficient number of persons to be sure that normal results have been obtained, and there is an additional note on tattooing, with illustrations.

MR. HENRY FROWDE, Oxford University Press, announces the forthcoming publication of a monograph on "The Micro-organism of Faulty Rum," by Prof. V. H. Veley, F.R.S., and Lilian J. Veley (*née* Gould). This micro-organism, which is said to have caused damage to the extent of many thousands of pounds, has only recently been isolated.

PROF. WILHELM WUNDT'S "Grundriss der Psychologie" (Leipzig: Engelmann. London: Williams and Norgate) has reached a third edition. The original work, noticed in NATURE, vol. liii. p. 604, 1896, has been revised and slightly enlarged.—Mr. Engelmann has also just published a second enlarged edition of Prof. Karl Eckstein's "Repetitorium der Zoologie." The work has been completely revised, and many additions have been made in the various sections.

A SECOND edition of the late Carl Reutti's "Ubersicht der Lepidopteren-Fauna des Grossherzogtums Baden" has been published by the Gebrüder Borntraeger, Berlin. The new edition has been prepared by Dr. A. Spuler, who was commissioned by the Karlsruhe Naturwissenschaftlich Verein and Herr Adolf Meess to undertake the work.—MM. Gauthier-Villars, Paris, have published a second edition of M. de Fonvielle's "Ballons-Sondes," a little volume containing an account of the methods and results of experiments with free balloons sent up with recording meteorological instruments.

THE different methods of recording the movements of seismographs form the subject of a brief, but useful, paper by Dr. Cancani in the last number of the *Bollettino* of the Italian Seismological Society (vol. iv. p. 73). Omitting the photographic method on account of its expense and neglect of details, there remain two others, in one of which the record is traced in ink flowing from counterpoised pens, and in the second on smoked paper by means of very fine threads of glass. Dr. Cancani has recently employed both methods at the Rocca di Papa Observatory, and decides without hesitation in favour of the latter, the diagrams being clearer and the friction of the pointers very much less.

TWO remarkably cheap and good globes—one celestial and one terrestrial—published by Messrs. George Philip and Son, have been sent to us for notice. Each globe is 6 inches in diameter, and is mounted in a solid brass semi-meridian on a polished stand. The celestial globe has upon it all stars down to the fifth magnitude, printed in white upon a dark blue ground; and also some nebulae and star-clusters. The stars are considered to be viewed from a point outside the globe, and not, as is the case with celestial globes usually, from the inside. The globe may thus be regarded as a collection of star-maps mounted for convenience upon a sphere. The terrestrial globe is very clearly printed; it shows ocean currents, steamer routes, and other matters of geographical importance. Both globes will be of assistance to teachers of geography, but their educational value would have been increased had it been possible to include a horizon with each of them.

MESSRS. GRIFFIN AND SONS, LTD., wish attention drawn to the fact that they have recently removed from their old premises in Garrick Street, Covent Garden, to 20–26, Sardinia Street, Lincoln's Inn Fields, London, W.C., where buildings have been specially constructed for their work. The same firm has just published the eighth edition of their catalogue of electrical apparatus, a copy of which has been sent to us. Among the scientific instruments and appliances included in the list are several noteworthy things. It is pointed out that Wimshurst machines with ebonite plates have many advantages over the glass plate machines, not the least being that they are not so liable to breakages. In the section of the catalogue containing

apparatus for experiments in voltaic electricity we notice a useful school galvanometer, having several novel features, and constructed in such a way that it can be entirely dismounted so as to explain the method of construction before the students in a class. Great care appears to be taken in the manufacture of resistance coils, all of them being tested and adjusted to within one-hundredth per cent. or one per cent. (according to price) of their value. In the magnetic section an interesting instrument described is Lenard's bismuth spiral for measurements of magnetic fields. The principle upon which the instrument is based is the change of resistance that occurs in bismuth when in a magnetic field; the alteration of resistance affording a means of determining the number of lines of force in the field tested. Many other instruments mentioned in the list show that Messrs. Griffin keep in touch with recent advances and educational requirements.

THE *Electrical Review* for November 25 contains an interesting account, with illustrations, of the electrolytic chlorate works at St. Michel in Savoy. Power is supplied by the river Arc, sixteen turbines, each keyed to a dynamo, being employed. The solution of potassium chloride is placed in insulated vats lined with lead, and having a capacity of 11,000 gallons. The anodes are of platinum-iridium, and the kathodes of iron-nickel alloy. The primary electrolytic action is, of course, the resolution of the potassium chloride into potassium and chlorine; the potassium, however, forms potassium hydrate, and liberates hydrogen at the kathode. The potassium hydrate so formed is now brought under the influence of the chlorine liberated at the anode; and as a sufficient current density is employed to keep the temperature above 45°, the action proceeds according to the equation $6KOH + 3Cl_2 = KClO_3 + 5KCl + 3H_2O$. The chlorate is easily separated from the more soluble chloride by crystallisation. The works at St. Michel, and another at Vallorbes, are said to produce together 1800 tons of chlorate per annum. The introduction of the electrolytic process has resulted in a considerable fall in the price of chlorates.

THE additions to the Zoological Society's Gardens during the past week include a Mozambique Monkey (*Cercopithecus pygerythrus*) from East Africa, presented by Mr. A. D. Michael; a Mantell's Apteryx (*Apteryx mantelli*) from New Zealand, presented by Sir Walter Buller, K.C.M.G., F.R.S.; two Dwarf Chameleons (*Chamaeleon pumilus*) from South Africa, presented respectively by Mrs. Todd and Mrs. C. Faraday Maypee; a Black Ape (*Cynopithecus niger*) from the Celebes, an Osprey *Pandion haliaetus*) captured at sea, a Praslin Parrot (*Coracopsis barklyi*) from Praslin Island, a Bell's Cinixys (*Cinixys belliana*) from Tropical Africa; a Home's Cinixys (*Cinixys homeana*) from West Africa, three Painted Terrapins (*Chrysemys picta*), a Salt-water Terrapin (*Malacoclemmys terrapin*) from North America, three Reeve's Terrapins (*Damonia reevesi*), a Black-headed Terrapin (*Damonia reevesi unicolor*) from China, four Caspian Terrapins (*Clemmys caspica*) from Western Asia, a Japanese Terrapin (*Clemmys japonica*) from Japan, four European Pond-Tortoises (*Emys orbicularis*), European, a Ceylonese Terrapin (*Nicoria trijuga*) from India, two Blackish Sternotheres (*Sternothaerus derbianus*) from Madagascar, a Spix's Platemys (*Platemys spixi*) from Brazil, a Common Chameleon (*Chamaeleon vulgaris*) from North Africa, two Rufescent Snakes (*Leptodira hotamboeia*) from South Africa, deposited.

OUR ASTRONOMICAL COLUMN.

THE NEW COMET CHASE.—This comet seems to be brightening, and is now in a good position for observation. It is moving slowly towards the north-west, being situated now in the southern part of the constellation of Leo Minor, roughly in a prolongation of the line joining π and γ Leonis. The Centralstelle sends us a circular (No. 15), which informs us of the elements and a brief ephemeris computed by Coddington from observations made on November 23, 24 and 25. Another circular (No. 16), which has just come to hand, informs us of more accurate elements and ephemeris which have been computed by Herr. J. Müller from two Harvard photographs taken on November 14, and two Lick observations made on November 23 and 25. These are as follows:—

T = 1898 September 8·192 Berlin M.T.

ω =	358° 43′·83	1898·0
Ω =	93 49·05	
i =	21 35·35	
log *q* =	0·33144	

Ephemeris, Berlin Midnight.

1898.	R.A. h. m. s.	Decl.	Br.
Dec. 8 ...	10 41 13 ...	+25° 3′·2 ...	1·4
,, 10 ...	10 43 32 ...	25 17·9 ...	1·4
,, 12 ...	10 45 45 ...	25 33·3 ...	1·4
,, 14 ...	10 47 51 ...	+25 49·3 ...	1·4

THE NEBULA OF ANDROMEDA.—The variation in brightness of a portion of the nebula of Andromeda, as announced by Seraphimoff some weeks ago, does not seem to have been generally corroborated, and the observations of Prof. Barnard (*Astrophysical Journal* for November) do not suggest any variation. In June and July of the present year this observer made a series of measures of the nucleus with reference to two eleventh magnitude stars, one preceding and the other south, and during this time the nucleus was well seen, though not stellar. No trace of the Nova of 1885, although carefully looked for, could be observed. After Seraphimoff's announcement both the 40-inch and the 12-inch telescopes were turned on to the nebula, but "it was evident that no perceptible change had occurred in the nucleus or the nebula itself . . . and the impression has always been that the nebula is unchanged."

Not only this observer, but both Hartwig at Bamberg and Comas Sola at Catala (*Astr. Nach.* No. 3529), record no variation; the former from eye observations and the lattet from photographs taken before and after the announcement mentioned above.

THE PLANET WITT DQ.—In a previous number of NATURE (November 3) we brought together much of the information that had been published concerning the interesting new planet discovered by Witt. The importance of this small planet, which at times approaches the sun nearer than Mars, necessitates that it should be closely watched, and its motion accurately determined. Needless to say, such observations are being carried out in many observatories, so that when a sufficiently large part of the orbit has been described we shall be presented with more accurate elements. The elements previously published by Berberich show now deviations from the true ones as gathered from the observed and calculated positions of the planet. Mr. H. N. Russell, of Princeton (the *Astronomical Journal*, Nos. 448–450), has formed some new normal places from a comparison of several observations, and the elements he has deduced differ somewhat from those previously published. Millosevich, in an interesting contribution to the *Rendiconti della R. Accademia dei Lincei* (vol. vii., series 5A), has also computed some new elements, so we give the following comparison:

	Berberich.	Russell.	Millosevich.
Epoch.	1898 Aug. 31·5. M.T. Berlin.	id.	id.
M	220° 14′ 3″·7	224° 33′ 12″·3	222° 23′ 28″·7
ω	178 28 26·2	175 47 50·1	170 1 20·8
Ω	0 3 48 53·0	303 20 20·3	303 24 53·1
i	311 6 57·1	10 45 1·8	10 45 18·1
φ	13 13 3·8	12 55 13·6	12 49 5·4
	1898·0	1898·0	1898·0
μ	2010″·131	2003″·86	2015″·119
log *a*	0·164521	0·1654245	0·163804
Period	645 days.	646·75 days.	644·06 days.

Prof. Simon Newcomb, in the same number of the *Astronomical Journal*, refers to the future oppositions of this planet

for the determination of solar parallax. The next most favourable opposition will occur in 1900 in November and December, so he gives a rough ephemeris for this period of approach. As this table will probably be useful for reference, we reproduce it below :—

	α	δ	Δ
	h. m.		
1900 Nov. 15 ...	1 56 ...	+ 54·7 ...	0·358
20 ...	45 ...	54·0 ...	·346
25 ...	38 ...	52·7 ...	·336
30 ...	32 ...	51·5 ...	·328
Dec. 5 ...	30 ...	49·7 ...	·322
10 ...	32 ...	48·2 ...	·314
15 ...	34 ...	46·0 ...	·309
20 ...	42 ...	43·9 ...	·310
25 ...	1 48 ...	+ 41·3 ...	0·308

In the northern hemisphere the position of the planet among the stars can be fixed from hour to hour both by the photographic telescope and the heliometer. "The combination of observations," as Prof. Newcomb remarks, "in the eastern and western hemispheres will then, it may be hoped, suffice for the best determination of the solar parallax yet made by direct measurement."

A NEW ALGOL VARIABLE.—Mr. Edwin F. Sawyer describes, in the *Astronomical Journal* (Nos. 448–450), the observations of a variable which he shows to be of the Algol type. The star in question is D.M. +12° 3557, and has a period of 21h. 21m., the fluctuations in brightness being about half a magnitude, namely, from 7·0 to 7·5. The intervals of time from maximum to minimum and from minimum to maximum occupy individually two hours and a half. The table containing the observations, which Mr. Sawyer has made between September 15, 1895, and October 27 of this year, shows that the star was near its minimum on September 9 and 16, October 3, 10, 11, 12, 20 and 27. Combining these observations with others made at Potsdam, the epoch and period have been approximately determined as 1898 October 3, 13h. 1m. Greenwich mean time, and + 0d. 21h. 21m. E. respectively. It is not without interest to note that this star, which is No. 2510 of the *Potsdam Photometric Catalogue*, was observed once each by Kempf and Müller on September 24, 1888, as 7·74m., and on October 29, 1890, as 7·57m. On each of these occasions the variable was near a minimum ; but as the observations agreed so well, the final value 7·66m. was entered in their catalogue. The magnitude given in the *Durchmusterung* was 7·0.

THE GEMINIDS.—So unfavourable was the weather for meteor observations during last month, that it is very doubtful whether the Leonids and Andromedes were observed at all in England. At the end of this week, December 10–12, there will be a well-known shower emanating from Gemini ; but although furnishing us with thirty or forty meteors in an hour, it does not compare with the sometimes magnificent displays that have been set down to the other two meteor swarms above mentioned. The absence of the moon on this occasion should render observations favourable.

THE ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

ON Wednesday in last week, being St. Andrew's Day, the Anniversary Meeting of the Royal Society was held in their apartments at Burlington House. The Auditors of the Treasurer's accounts having read their report, and the Secretary having read the list of Fellows elected and deceased since the last anniversary, the President (Lord Lister) proceeded to deliver the anniversary address. After the first part, containing obituary notices of the deceased Fellows, it proceeded as follows :—

The business of the Society during the past year has been fully dealt with in the Report of the Council[1]; and I have little to add to that statement. On the death of Sylvester, it occurred to some admirers of his great mathematical genius that it would be well to create a permanent memorial of him in connection with the Society by founding a medal to be called after his name. The Council, though not disposed as a general rule to add to the numerous distinctions of that character already at their disposal, felt that this was an exceptional case, partly on the ground of Sylvester's great distinction, and partly because, while there are several specialised medals, there is none devoted to the supremely important subject of pure mathematics. They, therefore, expressed their grateful approval of the proposal ; and I have now to announce that the fund raised for the purpose being closed, amounting to rather more than 880*l.*, a clear capital of 800*l.*, together with the dies, will shortly be transferred to the Society. The dies are being engraved after designs by Sir John Evans.

The help given in this matter by our Treasurer is but a small sample of the multitude of services which he has rendered to the Society during the past twenty years, in addition to the discharge of his official duties. How well these have been performed they only can know who, like myself, have served with him in office. The debt which the Royal Society owes to Sir John Evans has been referred to by the Council in terms of high, though not exaggerated, eulogy. I cannot but add the expression of my personal sense of the deep, I had almost said the irreparable loss which the Society sustains by his retirement.

The question who should be recommended to your suffrages as his successor has engaged the anxious deliberation of the Council. As stated in the report, various considerations have weighed with them. But I feel confident that, as time passes, the wisdom of the decision arrived at will be universally recognised.

Sir George Hamilton has, I believe, done wisely in sending out to India a British Commission, containing a majority of scientific experts, to inquire into the subject of the Plague ; and I am glad that so distinguished a Fellow of the Society as Prof. Fraser of Edinburgh has been able to accept the position of Chairman.

The recent sad occurrences at Vienna may suggest the fear that our countrymen engaged in this duty, will be subjected to grave danger. But the disease as it showed itself in Vienna, was of an entirely exceptional form ; and if we consider how few of the medical men and nurses who have for a long time past been engaged in actual attendance on plague-stricken patients, have fallen victims to the disease, we may dismiss from our minds the idea of any serious risk to the commissioners.

Their chief duties will, I believe, be to sift and report upon the somewhat heterogeneous and scattered pieces of evidence already published by various observers as to the nature and modes of transmission of the complaint, and the best means of dealing with it. One of the subjects which will engage their attention will be the efficacy or otherwise of the preventive injections of Monsieur Haffkine. On this question our Fellows are likely to have an opportunity of judging for themselves ; for Haffkine himself has agreed to come over to this country in May, a time of the year at which his services in India can best be spared, in order to bring his facts before us at one of the "meetings for discussion."

There is no subject in Biology of greater interest at the present time, whether in a scientific or practical point of view, than that of the "serum therapeutics" of infective diseases. According to a recent report, which bears throughout the characters of authenticity,[1] a great success in this direction has been lately achieved. Mr. Chamberlain, whose enlightened action regarding malaria and allied disorders in Africa, has been referred to in the Council's report, consulted the Royal Society about two years ago as to the possibility of devising some means of arresting the fearful ravages of rinderpest among the cattle in the southern parts of that continent. The stamping-out process by wholesale slaughter which, at great expense to the country, formerly proved effectual in England, could not be thought of in South Africa, whose vast regions are sparsely populated, while buffaloes and other animals beyond human control are able to contract and spread the disease. But could nothing be done by modern scientific methods? The subject appeared full of hope, because, as was shown long ago in this country by Burdon-Sanderson, rinderpest resembles small-pox in the fact that one attack, if recovered from, protects against a recurrence of the disease.

Mr. Chamberlain was fortunate in securing, with the consent of the German Government, the services of that distinguished bacteriologist, Prof. Koch. We rejoiced to read the reports of his masterly researches and of the brilliant results which he obtained, promising to effect all that could be desired. The

[1] This Report has not reached us.

[1] *Vide* "Rinderpest in South Africa," by John Maberly. *The Lancet*, November 5, 1898.

process which he devised did indeed, as we are informed, save the lives of thousands of cattle. In course of time, however, it turned out that the immunity conferred by it was not sufficiently permanent, while it was attended with some other serious practical inconveniences. Hence it became necessary to seek for some more perfect method. This has been done by a German investigator, Dr. Kolle, who went out to continue Koch's work, acting in co-operation with one whom I am patriotic enough to be pleased to speak of as an Englishman, Dr. George Turner, the Government Health Officer of Cape Colony. Koch had early ascertained that the serum of an animal which had recovered from rinderpest, if injected under the skin of a healthy animal, conferred upon it complete though very transient immunity. This was the basis of the work of Kolle and Turner, who, after a long series of laborious investigations, have, it appears, at length attained their object by simultaneously injecting, at two distant parts of the animal's body, a little of the antitoxic serum, and a dose of the blood of a diseased animal, which, without the serum, would prove certainly fatal. The result is that the beast becomes affected with the disease in a form so greatly modified that it causes as a rule, only slight symptoms, and sometimes none at all; and, though it occasionally proves fatal, it does so in considerably less than 1 per cent. of the cattle subjected to it, contrasting most strikingly with ordinary rinderpest, which kills from 80 to 90 per cent. of those affected. And, just as in the case of vaccination, this modified and mild form of the disease confers protection against it in its most virulent condition; so that even the beasts in which the treatment had produced no symptoms at all remained absolutely unaffected when tested subsequently with a dose of infective material sufficient to kill 10,000 full-grown oxen. This immunity is also of a very lasting character; and, indeed, so far as experience has yet gone, it may be as permanent as that caused by an ordinary attack.

This process was very extensively employed as a prophylactic in the herds of South Africa, during the raging of the epidemic, and with most remarkable success. According to an estimate based on the Cape Government statistics, the effect of the preventive inoculations carried out during the last two years, including those by Koch's method, has been to cause the saving of the lives of upwards of 700,000 head of cattle. It is believed that, had it not been for these prophylactic labours, the number of cattle remaining in the country, instead of being, as now, upwards of a million, would have been little more than 300,000. And it is to be remembered that these are the gross results, including not only those of the present method, but also those of the comparatively imperfect processes that led up to it.

Assuming, as I believe we may, that the report from which these statements are drawn is entirely worthy of confidence, we have here a striking example of beneficent application of science.

Among the many important matters that have come before us during the past year, some in the domain of chemistry seem to stand out as especially striking. One of these is the liquefacton of hydrogen by Prof. Dewar. In previous attempts by Olszewski and himself, drops of clear liquid had been seen which it was supposed were composed of that element; but no one could be quite sure that these were not merely the result of the condensation of other gases which it is extremely difficult to get rid of completely. None could be certain that hydrogen, if liquefied, would not present, like mercury, the appearance of a metal. Dewar, however, after long continued persevering effort, succeeded in producing a liquid in bulk, with well defined meniscus, which, in one of his wonderfully effective vacuum-coated vessels, could be manipulated experimentally, as liquid air had been, allowing at once the determination of some of its physical constants, and liquefying the previously refractory helium, implying a lower temperature than had ever before been attained by man. This achievement is not only of supreme interest in itself but opens up an entirely new field for investigations into the properties of matter.

Liquefied gases have been the means by which Prof. Ramsay has been able to obtain his recent very remarkable results. As chairman of the Chemical Section of the British Association at Toronto he had boldly taken as the subject of his opening address an unknown element, of the existence of which he felt confident from theoretical considerations. He believed that there must exist such a body with an atomic weight intermediate between those of argon and helium. He sought for this element, hoping to find it locked up, like helium, in some mineral, and in other ways tried to discover it. But in a paper presented to the Society early in this year, he was obliged to confess that all his efforts had been fruitless. At the same time in that paper he again expounded his reasons for believing in the existence of the unknown body. He has since adopted a new line of investigation. Having at his disposal a large supply of liquid air, he tried with it the method of fractional distillation; and after allowing the main bulk to evaporate, proceeded to volatilise and test the residue. In this he did indeed find what appears to be a new elementary body, to which he gave the name of Krypton. But so far from complying with his requirements, this gas was found to be much denser than argon; indeed it is thought probable by Ramsay that it has twice its density, and therefore, being, like argon, monatomic, twice its atomic weight. Ramsay, however, had another resource at his command. Aided by Mr. Travers, who has throughout this inquiry most ably seconded him, he had, by long continued labour, procured a large store of argon. This he liquefied by subjecting it to the cold of boiling liquid air; and surmising that any element lighter than argon would be present in the superjacent vapour, he collected this and subjected it to analysis. And now he found what he had so long sought for, a new elementary gas with atomic weight intermediate between those of argon and helium. To this he gave the name of Neon.

But this was not all. As the argon liquefied at the low temperature caused by boiling liquid air, a white solid was seen to be deposited in it, and this remained after all the liquid had evaporated. This solid, on being volatilised and tested, was found to be, as is believed, another new element. This, though very unlike argon in physical characters, possesses a nearly, if not absolutely identical atomic weight; just as some metals with very similar atomic weights differ in their qualities. This element has therefore received the appellation Metargon.

Such is a most rough sketch of two samples of the work of the Society during the past year.

The President then proceeded to award the medals.

The Copley Medal is awarded to Sir William Huggins for his great achievements in the application of spectrum analysis to the heavenly bodies.

His first results in this direction were obtained early in 1864. At the commencement of his labours in his observatory at Tulse Hill, he worked in conjunction with the late Prof. Miller. By visual observation a multitude of lines in the spectra of Betelgeux and Aldebaran were carefully measured, mapped, and compared with those of terrestrial elements. This is notable as being the first application of thoroughly precise methods to the study of the spectra of stars, and as showing the presence of terrestrial elements in them.

On August 29, 1864, Huggins discovered the bright line spectrum characteristic of certain nebulae. This must always be regarded as one of his chief titles to fame. It was an epoch-making discovery, for it established in an unquestionable manner that some of these objects were veritably gaseous. The interest of this work was greatly increased by the fact that, by comparison with the spectrum of terrestrial hydrogen, Huggins showed that one of the nebular lines belonged to that substance.

In 1868, Huggins applied the principle of Doppler to the measurement of stellar movements in the line of sight. He thus originated a department of spectroscopy which has been considered to be perhaps the most instructive application of spectrum analysis to astronomy. Notable results were obtained by Huggins himself in the application of this method, and it has led to many remarkable developments in the hands of other astronomers. By following the course which Huggins originated, wholly new classes of double stars have been revealed, the movements of Algol have been explained, and the mathematical theory of Saturn's ring has been visually confirmed.

The appearance of Winnecke's comet, in the year 1868, gave Huggins the opportunity of studying, for the first time, the spectrum of one of those bodies. He found bright lines in the spectrum of the comet which agreed with those of olefiant gas. Thus he established the fact that carbon was a constituent of comets.

The spectrum of Vega had been photographed by H. Draper, in 1872. In 1876, Huggins obtained a photograph of the spectrum of the same star. He then discovered the remarkable series of hydrogen lines characteristic of the spectra of the class of so-called white stars which includes Sirius as well as Vega. The very beautiful system of hydrogen lines in this ultra-violet

spectrum was described by Huggins to the Royal Society in 1879.

In 1881, Huggins succeeded in photographing the spectrum of Tebbutt's comet, and, availing himself of the various improved appliances which were suggested by his unique experience, he photographed the spectrum of the Orion nebulae in 1882. In 1888, a still better photograph of the same spectrum was obtained by Dr. and Mrs. Huggins. There was a special interest about this plate. It showed that certain bright lines were common to the nebula and to the trapezium stars, thus establishing the connection between the stars and the nebulae. Further investigations of the same object were also made in 1889. In that same year the spectrum of Uranus was investigated photographically by Dr. and Mrs. Huggins, and was shown to be essentially solar. In 1890, the chief line in the nebular spectrum was accurately re-determined, and an investigation was made by Dr. and Mrs. Huggins of the spectra of Wolf and Rayet's stars in Cygnus.

The most recent work from the Tulse Hill Observatory has been the investigation of the remarkable ultra-violet lines of calcium, by which the characteristics of these lines in the solar spectrum have been explained.

A sketch of the early history of spectroscopic astronomy was given by Dr. Huggins to the British Association, at Nottingham, in 1866. A review of the same subject a quarter of a century later is found in his Presidential Address at the Cardiff Meeting of the Association in 1891. Reference must also be made to a lecture on the remarkable star, Nova Aurigae, given at the Royal Institution in 1892.

A full list of Huggins's papers, up to the year 1894, is found in Frost's translation of Scheiner's "Astronomical Spectroscopy," published by Ginn and Co., 1894.

The Rumford Medal is given to Prof. Oliver J. Lodge in recognition of his researches on radiation and on the relations between matter and ether.

In dealing with the history of the discovery by Prof. Hertz of electro-magnetic radiation, it would be impossible to pass over the work done previously, or simultaneously, by Prof. Lodge, on the surging or oscillatory character of the transmission of electric discharges along wires.

Prof. Lodge gave an account of his observations in his lectures to the Society of Arts, delivered in 1888, which are incorporated in his treatise on "Lightning Conductors and Lightning Guards," published in 1892.

The researches of the English and German physicists were entirely independent, and though the merit of the actual discovery of electro-magnetic radiation belongs certainly to Prof. Hertz, there seems little reason to doubt that Prof. Lodge's experiments would have led him eventually to the same result. Prof. Hertz himself says, in the introduction to his work, "Ueber die Ausbreitung der Elektrischen Kraft": "Inasmuch as he" (Prof. Lodge) "entirely accepted Maxwell's views, and eagerly strove to verify them, there can scarcely be any doubt that, if I had not anticipated him, he would also have succeeded in observing waves in air, and thus also in proving the propagation with time of electric force" (p. 3, English edition).

When the discovery of electro-magnetic radiation was announced, Prof. Lodge at once recognised its great importance, and by his lectures and writings contributed largely to make known to this country the brilliant achievement of Hertz. At the same time, by his experimental investigations, he added considerably to the knowledge of the subject, and materially strengthened the evidence that electro-magnetic waves exhibit similar properties to those which have been for a long time assigned to the ethereal disturbances assumed to constitute the mechanism by which are produced the phenomena of light.

Prof. Lodge's introduction of the "coherer"—an instrument the action of which is based on observations made independently by himself and M. Branly—as a substitute for the Hertz "resonator," has increased in a marked degree the facility for reproducing and extending the experiments of Prof. Hertz, and has furnished the means of exhibiting much more conspicuously he results obtained.

More recently Prof. Lodge has been engaged in investigating the phenomena presented by the Röntgen rays, and the circumstances under which these rays are produced. He has also studied the effect on the light emitted from a source placed in a powerful magnetic field, which was discovered by Prof. Zeeman.

In connection with all these branches of inquiry, he has communicated to scientific societies and to periodicals a large number of papers, containing valuable contributions to our knowledge of radiations in ether, and suggestive speculations as to the properties of the ether itself.

With the object of obtainlng some information as to the properties of the ether, and of ascertaining whether any mechanical connection can be detected between matter and ether, Prof. Lodge carried out an elaborate series of experiments, of which the record appears in the *Philosophical Transactions*, vols. 184 and 189. The special aim of this research was to determine whether a moving mass communicates any corresponding motion to the ether in its immediate neighbourhood, or, in other words, to determine whether the ether has any apparent adhesion to matter, and possesses any property of the nature of, or analogous to, viscosity.

His method of observation is to divide a beam of light into two of equal intensity, and to cause the latter to traverse in opposite directions an annular space in a steel or iron disc. The two beams are superposed so as to produce interference-bands. If any appreciable motion can be communicated to the ether in the annulus by causing the disc to revolve rapidly round the common axis of the disc and annulus, it is practically certain that some change must be produced in the velocity of the light in the two beams, and this change must show itself by an observable displacement of the interference-bands.

No such displacement was observed with any velocity of the disc which could be attained, nor could any shift of the bands be detected when the annulus in the revolving disc was converted into a powerful magnetic field, or was subjected to strong electrification.

The absence of any noticeable effect upon the light in these experiments is taken to indicate that matter has no appreciable hold upon the ether in its neighbourhood, and that no power of gripping the ether is conferred upon matter either by magnetisation or electrification of the kind employed.

[As it is a condition that a part at least of the work on which a claim to the Rumford Medal can be founded should have been published during the two years preceding the award, a list is appended containing the titles of some of Prof. Lodge's papers which have appeared during 1896–98:—

(1) "Experiments on the Absence of Mechanical Connection between Ether and Matter" (*Phil. Trans.*, A, 1897, vol. 189).

(2) "The Influence of a Magnetic Field on Radiation Frequency" (*Roy. Soc. Proc.*, vol. 60).

(3) "Further Note on the Influence of a Magnetic Field on Radiation Frequency" (*Roy. Soc. Proc.*, vol. 61).

(4) "Note on Mr. Sutherland's Objection to the Conclusiveness of the Michelson-Morley Aether Experiment" (*Phil. Mag.*, vol 46).

(5) "On the Rays of Lenard and Röntgen" (*Electrician*, vol. 46).

(6) "On the Present Hypotheses concerning the Nature of Röntgen Rays" (*Electrician*, vol. 36).

(7) "Further Progress in Radiography" (*Electrician*, vol. 36).

(8) "Röntgen Rays" (*Electrician*, vol. 37).

(9) "The Surviving Hypothesis concerning the X-Rays" (*Electrician*, vol. 37).

Several short notes on subjects connected with Radiation have appeared in NATURE during 1896–98.]

One of the Royal Medals is bestowed upon the Rev. John Kerr, as the author of extremely important experimental researches on the optical relations of electricity and magnetism.

Dr. Kerr has made a name, which will always be remembered in the history of science, by his experiments on the optical effects of electrical and mechanical stress, and on the polarisation of light reflected from the surface of a magnetised body.

His observations on electrical stress were recorded in a series of papers published in the *Phil. Mag.* in 1875, 1879 and 1882, in which he demonstrated the fact that the velocity of polarised light in a body subjected to electrostatic influence is different according as the plane of polarisation is parallel or perpendicular to the lines of electric force.

In these experiments he was led to use mechanically strained glass as an auxiliary apparatus, and in October 1888, he published, in the *Phil. Mag.*, an important paper on "The Birefringent Action of Strained Glass."

In 1877, Dr. Kerr (*Phil. Mag.* [5], vol. 3, p. 321) showed that if plane polarised light is reflected from a magnetised surface, the polarisation of the reflected ray is affected by the

magnetic state of the surface. This result was of the highest theoretical interest, and it has been a matter of admiration and wonder to subsequent investigators that Dr. Kerr should have been able to learn so much with the comparatively simple and ineffective apparatus at his disposal.

Both of Dr. Kerr's great researches have been the starting points of numerous inquiries. His experiments on electrical stress have been repeated and extended by Gordon, Quincke, Röntgen, and others, while Fitzgerald, Righi, Kundt, Lorentz, Sissingh, Zeeman, J. J. Thomson, Du Bois, Goldhammer, Drude and Leathem, are among those who have been occupied with the extension or theoretical meaning of his work.

Dr. Kerr's researches rank among the most important of those which have been made since the time of Faraday.

The other Royal Medal is conferred on Mr. Walter Gardiner, who has taken a leading part in what is perhaps the most important recent advance in Vegetable Histology, namely, the discovery that the protoplasm in the tissues of plants is continuous from cell to cell, and not broken up into isolated portions by the cell-walls. His first work on the subject dates from 1882, when he published in the *Quarterly Journal of Microscopical Science* a short paper on "Open Communication between the Cells in the Pulvinus of *Mimosa pudica*." Up to that time protoplasmic continuity in plants had only been recognised in the special case of the sieve-tubes and in the endosperms of three species; and even in these instances the evidence that the connecting threads were really of protoplasmic nature was not, in Mr. Gardiner's opinion, conclusive.

In 1883 he presented to the Royal Society an extensive memoir "On the Continuity of the Protoplasm through the Walls of Vegetable Cells" (*Phil. Trans.*, pt. 3, 1883), in which he demonstrated that this structure is constant in the endosperm, and that it also occurs in various tissues of the plant. Mr. Gardiner at that time thought it probable that the phenomenon might be of universal occurrence, and dwelt on its great physiological significance.

In the meantime other observers took up the subject, and the generality of protoplasmic continuity in plants came to be widely recognised by botanists. Mr. Gardiner, however, was severely critical of his own methods and results, and was not satisfied that the evidence, though conclusive in so many cases, was strong enough to bear the weight of so wide a generalisation. He therefore set himself, within the last few years, to re-investigate the subject, with the aid of more refined processes which he had adapted and elaborated.

The results of his renewed work were communicated to the Royal Society last year, in a paper on "The Histology of the Cell-wall, with special reference to the Mode of Connection of Cells" (*Roy. Soc. Proc.*, vol. 62, p. 100). In this work he shows for the first time, that the connecting fibrils of protoplasm can be demonstrated with certainty in all kinds of vegetable tissues, and he is also enabled to make the important statement that "the threads appear to be present *ab initio*."

Mr. Gardiner has done much good work in other departments of the Histology and Physiology of Plants, notably on glandular structures; on the function of tannin; on protoplasmic contractility; and on the phenomena accompanying stimulation in insectivorous plants. His scientific reputation, however, rests chiefly on the fact that to him, more than to any other investigator, is due the discovery of the continuity of protoplasm in plants—a discovery which essentially modifies our whole conception of vegetable organisation.

The Davy Medal is awarded to Prof. Johannes Wislicenus for his numerous and important contributions to Organic Chemistry, embodied in a series of papers extending over the last thirty-five years, and published in the *Berichte* of the German Chemical Society, Liebig's *Annalen*, and elsewhere. The researches undertaken by Prof. Wislicenus and his pupils, inspired by the zeal of their master, have flowed, almost without intermission during the period mentioned, from the laboratories of Zürich, Würzburg and Leipzig. Among his earlier work may be mentioned his classical researches on the lactic acids, which finally settled the much-debated questions concerning the combination of acid and alcoholic properties in oxy-acids in general. These researches threw much light on the subject of the isomerism of the oxypropionic acids. He ascertained the nature of the action of silver oxide on β-iodopropionic acid, while his improved synthesis of ordinary lactic acid from aldehyde, and of β-oxypropionic acid from glycollic chlorhydrin, established the relations of these acids to their respective radicles, ethylidene and ethylene. His study of sarcolactic acid was a notable contribution to the subject of the optical activity of organic compounds, and resulted in the important discovery for the first time of two substances having a structure of proved chemical identity, and yet possessing different physical properties.

The prominent part taken by Wislicenus in unravelling the reactions concerned in the formation of aceto-acetic ester, and in the application of this compound as a synthetical agent, is well known to all chemists. He devised a practical method for its preparation, and was the first to use the isolated substance as the starting point of synthetical operations. He defined the acid property of the replaceable hydrogen atom in this ester, and its homologues, and devised the now familiar methods for the use of the sodium derivatives in organic syntheses. He discovered the "acid" decomposition of the ester and its derivatives, and established the conditions under which the "ketonic" decomposition could be effected. He utilised his methods for the synthesis of compounds of the most varied types, such as mono- and polybasic acids, both saturated and unsaturated, oxy-acids and ketonic acids, ketones and alcohols.

More recently the name of Wislicenus has become closely associated with discovery in the new field of stereo-chemistry. As early as 1869 he pointed out the insufficiency of the ordinary "constitutional" formulae to explain the isomerism of ordinary and active lactic acid, and clearly stated that the explanation was to be found in the tridimensional arrangement of the atoms in space. Van 't Hoff states that it was this statement by Wislicenus which suggested to him the ideas which culminated in his well-known theory of the asymmetric carbon atom. Wislicenus boldly advocated the introduction of geometrical conceptions into the doctrine of the constitution of chemical molecules, and in his memoir "Ueber die räumliche Anordnung der Atome in organischen Molekulen," published in 1887, he extended the hypothesis of van 't Hoff, and showed how the spacial arrangements could be determined in special cases. The new ideas contained in this memoir had a most stimulating effect on the study of stereo-chemical isomerism. Of his own and his pupils' work in this field may be mentioned investigations of the tolane dichlorides, acetylene-dicarboxylic acid, the butylenes and derivatives of crotonic acid.

The Darwin Medal is given to Prof. Karl Pearson in recognition of the great biological importance of his work upon the Theory of Probability, and its relation to vital statistics. The importance of the theory of probability in dealing with the problems of organic evolution was first seen by Mr. Francis Galton. Prof. Pearson's merit lies in the fact that he has so far extended the mathematical theory of chance as to make it possible to treat generally problems which could previously be dealt with only in a few special cases. Prof. Pearson has shown, in various memoirs published in the *Philosophical Transactions* during the last five years, that the amount and frequency of organic variation, the degree of interdependence between one variable organ and others, the phenomena of heredity, and the intensity of selective destruction can be treated quantitatively by means of his development of the calculus of probability; and he has given examples of the treatment of variation and inheritance in man, and in a number of animals and plants.

A calculus by which the fundamental phenomena of organic evolution can be treated quantitatively provides an engine of biological research of a new and powerful kind, and, as a stimulus to new and more accurate investigation of the phenomena of organic evolution, it is of very great importance. The hypothesis of natural selection has hardly been proved by the direct demonstration of a selective death-rate, except in few and simple cases. The demonstration of such selective death-rate in more complex cases is rendered possible by Prof. Pearson's work. Such demonstration is the natural and logical sequel to the work of Darwin himself, and there is a peculiar fitness in awarding the Darwin Medal to the man who has made it possible.

The Society next proceeded to elect the officers and Council for the ensuing year. The list has already appeared in NATURE (p. 39).

In the evening the annual dinner took place at the Whitehall Rooms. Among the guests of the Society who made speeches were the Lord Chancellor, Lord Kitchener, and Lord Curzon.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The completion of the fiftieth year of Sir George Stokes' tenure of the Lucasian Professorship will be celebrated by the University on June 1 and 2, 1899. Invitations to assist will be issued to distinguished representatives of universities and learned societies, British and foreign. A grant of 400*l.* has been made by the University for the purpose, and it is understood that some permanent memorial of the occasion will be provided.

The Walsingham Medal has been awarded to Mr. J. Graham Kerr, of Christ's College, for his researches on *Lepidosiren*. Mr. A. C. Hill, of Trinity, is *proxime accessit*, and five other essays are pronounced by the adjudicators to be of a high order of merit.

A John Lucas Walker Studentship in Pathology, value 200*l.* a year for three years, is about to be vacant. Candidates, who may be of either sex, are to send in their names to Prof. Kanthack by January 18, 1899.

An Isaac Newton Studentship in Astronomy, value 200*l.* a year for three years, will be filled up next term. Candidates must be B.A.s under the age of twenty-five on January 1, 1899. Names are to be sent into the Vice-Chancellor between January 16 and 26.

The Sheepshanks Telescope Committee report that the erection of the polar-reflecting photographic telescope at the Observatory, with its building and dome, is nearly complete. Dr. Common has provided the mirror, and the object-glass is one of Cooke's triple lenses. The tube and apparatus are by Messrs. Grubb. The adjustments and tests have still to be carried out.

Mr. Shipley and Mr. Cronin are to represent the University at the centenary of the Imperial Military Academy at St. Petersburg at the end of this month.

INFORMATION of two examples of munificence to education and science reaches us from the United States. Mrs. Emmons Blaine has given 250,000 dollars to Chicago University for the establishment of a college for teachers. Miss Anna T. Jeanes has recently presented the Academy of Natural Sciences of Philadelphia with 20,000 dollars, the income to be used for museum purposes.

THE following Scholarships have been awarded in connection with the present Session 1898–99 of the Central Technical College:—Clothworkers' Scholarship, 60*l.* a year, to A. J. Cook; Mitchell Scholarship, 50*l.* a year, to R. H. Collins; John Samuel Scholarship, 30*l.* and free education, to F. C. Hounsfield; Institute's Free-Studentships to R. H. Buckie, A. W. Harrold, and W. H. P. Brounger.

THE *British Medical Journal* states that Mr. Alfred L. Jones has offered the sum of 350*l.* a year to establish and maintain a laboratory in Liverpool for the study of tropical diseases. The laboratory will be opened in association with the Royal Southern Hospital, and a Committee has been formed to carry out the scheme in connection with the hospital and with University College.

THE first number of a new monthly magazine, devoted to the principles and practice of teaching the subjects usually studied in secondary schools—by which is meant all schools, public and private, other than public elementary schools—will be published by Messrs. Macmillan in the middle of January next, under the title of *The School World*. The magazine is not designed to be an educational newspaper so much as a periodical for the publication of articles on methods of teaching, and of notes by experienced teachers on the treatment of difficulties met with in actual school work. Rational methods of teaching will be advocated so far as they are practicable under existing conditions in secondary schools, and articles will be published showing how they can be carried out. Among the contributors to the scientific section of early numbers of the magazine will be Prof. L. C. Miall, on experimental natural history; Prof. G. B. Mathews, on the teaching of algebra; and Dr. Francis Warner, on physical observations of boys and girls in schools. Other scientific subjects to be dealt with are the stars month by month, current geographical topics, and experimental general science.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, November.—The first "Cambridge Colloquium" was held at Buffalo in 1896. In consequence of the British Association holding its meeting in 1897 at Toronto there was no Colloquium held in that year. The second Colloquium was held in the present year (August 22–27), at Harvard University. Two courses of six lectures each were delivered, the lecturers being Profs. Osgood and Webster. The latter gentleman took as his text "The partial differential equations connected with wave propagation"—an abstract of this course is to be given in a future number. Prof. Osgood lectured "On some methods and problems of the general theory of functions." Lecture i. was devoted to Picard's theorem, and the application of Riemann's geometric methods in the general theory of functions. Lectures ii. and iii. discussed the representation of multiple-valued functions by means of single-valued functions of a parameter, treated geometrically by Riemann's methods and also Poincare's theorem. Lectures iv. and v. dwelt on some recent study of the relation between the properties of a function defined by a power series and the coefficients of that series. The last lecture was on certain Cantor's sets, and their application in a question concerning Cauchy's definition of an analytic function. The lectures are very fully reported, and illustrated with diagrams and bibliographical notes. The "Colloquium" is a very interesting and useful addition to the ordinary meetings of the Society. The above meeting was held at the same time as the American Association for the Advancement of Science held its semi-centennial meeting, at which about 900 members were present. The section of mathematics and astronomy was well attended. The committee of the section accepted twelve papers in pure mathematics, thirteen in applied mathematics, and sixteen in astronomy. The titles of these are given, and short abstracts of their contents follow. Interesting notes and a list of recent mathematical publications close the number. The *Bulletin* well maintains the high position it has attained.

American Journal of Mathematics, vol. xx. No. 4, (October 1898).—Sur l'intégration hydraulique des équations différentielles, by M. M. Petrovitch. The author writes: "Tous les intégraphes et les appareils pour l'intégration graphique des équations différentielles, proposés jusqu' aujourdhui, sont fondé sur l'emploi de certains principes cinématiques, p. ex. sur les propriétés des roulettes (*cf.* the Catalogue of Models, Apparatus and Instruments, by W. Dyck, Munich, 1892–3)." He shows briefly that these integrations can be effected in quite another way. "Supposons que l'on fasse immerger un corps solide M plus ou moins profondément dans le liquide contenu dans un vase B. Le niveau du liquide montera ou s'abaissera d'après une certaine loi dépendant de la forme du corps M et du vase B et ces formes une fois fixées, la variation de la hauteur du niveau y, comptée à partir d'un plan horizontal fixe, p. ex. à partir de la face inférieure du vase B ne dépendra que de la distance x entre l'extrémité e de la tige ef et la face inférieure du vase B." The principle is applied to the graphical integration of a certain type of differential equations of the first order. The article is illustrated with a few diagrams.—On the hyperelliptic sigma functions, by H. F. Baker. This memoir, which occupies pp. 301–384, appears to be a brilliant contribution to the literature of the Riemann surface.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 24.—"The Origin of the Gases evolved on heating Mineral Substances, Meteorites, &c." By Morris W. Travers, D.Sc. Communicated by Prof. W. Ramsay, F.R.S.

Conclusions.

It would appear that the only evidence on which the assumption that gases of a permanent character, such as hydrogen, carbon monoxide, nitrogen, helium, and argon, exist in the free state in the mineral substances from which they are evolved on heating, rests on certain observations with regard to the cavities which can sometimes be detected by microscopic examination.

The cavities may be either apparently empty or they may contain liquid, and when the mineral is warmed the liquid

disappears at a temperature which is a few degrees below the critical point of carbon dioxide or of some hydrocarbon. The fact that the critical temperature of the liquid is a little below the point corresponding to carbon dioxide, in the case of a mineral containing that substance is not, however, of very great significance as pointing to the presence of a permanent gas. A small quantity of methane would produce the same result (Kuenen, *Phil. Mag.*, 1897).

Further, although it can be shown that *compact* minerals do enclose carbon dioxide and hydrocarbons, gases which can easily be liquefied, the analogy cannot be extended to gases such as hydrogen and helium in connection with minerals like chlorite, mica, and clevite, which exhibit many cleavages.

On the other hand, there is, as I have endeavoured to show, a considerable amount of evidence in favour of the theory which I have put forward:—That in the *majority of cases* where a mineral substance evolves gas under the influence of heat, the gas is the product of the decomposition or interaction of its *non-gaseous* constituents at the moment of the experiment. The results of such experiments cannot, therefore, serve as basis for speculation as to origin and history of the substances in question.

Geological Society, November 2.—W. Whitaker, F.R.S., President, in the chair.—Sir A. Geikie drew attention to some specimens on the table which had been collected by the Geological Survey from the Silurian rocks of County Tipperary. These contained impressions that bore a close resemblance to flattened and drawn-out graptolites, and others that might be taken for mollusca or phyllopoda enlarged by cleavage. It seemed to him, however, extremely doubtful whether these forms were truly of organic origin. They were exhibited in the hope that the palaeontologists in the Society might be able to throw some light upon them from the zoological side.—Dr. G. J. Hinde exhibited and commented on specimens of Devonian rocks sent by Prof. Edgeworth David and Mr. Pittman from the railway-section at Tamworth, New South Wales, which had been received since their paper was read.—Note on a conglomerate near Melmerby (Cumberland) by J. E. Marr, F.R.S. In this paper the author describes the occurrence of a conglomeratic deposit which shows indubitable effects of earth-movement, not only on the included pebbles, but also on the surface of one of the deposits. The rocks are coloured as basement Carboniferous rocks on the Geological Survey map. Sir A. Geikie remarked that in his opinion the author had completely proved the point sought to be established. The peculiar features of the conglomerate described in the paper were obviously due to earth-movements, and not to glacial action. At the same time, while frankly admitting the explanation of the case now brought forward, he held that conclusive evidence had been obtained of glacially-striated boulders in old geological deposits. Other speakers supported Dr. Marr's view that the surface-features of the stones exhibited were due, not to glacial action, but to earth-movements. The author, in reply, stated that he had brought the case forward simply as an example which might be appealed to in future discussions, as showing exceptionally good indications of the various features produced by slickensiding.—Geology of the Great Central Railway (New Extension to London of the Manchester, Sheffield and Lincolnshire Railway): Rugby to Catesby, by Beeby Thompson.—On the Remains of *Amia* from Oligocene Strata in the Isle of Wight, by E. T. Newton, F.R.S.

Entomological Society, November 16.—Mr. R. Trimen, F.R.S., President, in the chair.—Mr. Tutt showed, for Mr. Herbert Williams, a series of specimens of *Pararge egeria* bred from eggs laid in July. A portion of the brood were forced, and the imagos, which emerged in November and December of the same year, showed marked darkening of the hind margin of the under side of the hind wings, and were of a greyer colour than those which appeared at the normal time. He also exhibited a batch of fifty specimens of *Amphidasys betularia* bred from ova deposited by a female captured in Essex. The progeny ranged from a colour rather lighter than the normal form to a blackish tint almost equal to that of var. *doubledayaria*; all intergrades were represented without sign of discontinuity.—Mr. H. J. Elwes gave an account of a journey undertaken by him in June and July of the present year to the Russian portion of the Altai mountains, partly for sport and partly to investigate the distribution of insects in that region, and the line of demarcation between the Eastern and Western Palaearctic sub-regions. He exhibited samples of 141 species of butterflies taken by himself. Of these many had not been previously recorded from the region, of which the total number of species now stood at 184; his list showed that the lepidopterous fauna had a more European and Siberian character than had been previously supposed, or than Seebohm had found to exist in the avifauna. The number of undescribed species taken was small, but several forms were previously known only from remote localities, such as *Melitaea iduna*, hitherto recorded from the fells of Lapland. Few Heterocera were taken, but among them was the third recorded example of *Arctia thulea*, Dalm.—Dr. A. G. Butler communicated a paper on some new species of African Pierinae in the collection of the British Museum, with notes on seasonal forms of *Belenois*.

Linnean Society, November 17.—Dr. A. Günther, F.R.S., President, in the chair.—Prof. Stewart, F.R.S., exhibited and made remarks on the skull of a fox that was described and figured by Bateson in his work on variation. Both upper canines had divided crowns. He also exhibited the double tusk of an Indian elephant. The tusk was two feet in length, and had a deep groove on its anterior and posterior surfaces. He considered that in both cases the condition was probably due to partial cleavage or grooving of the dental papilla. The President, referring to the exhibition of a somewhat similar tusk at the previous meeting, indicated the points in which the two examples differed.—A paper was read by Mr. F. Pickard Cambridge on some spiders from Chile and Peru, collected by Dr. Platte of Berlin. The collection was made during a journey extending from Tumbez, in Northern Peru, down the coast of Chile to Cape Horn, and contained nineteen species, of which seven proved to be new to science.—Mr. Spencer Le M. Moore read a paper entitled "The botanical results of a journey into the interior of Western Australia; with some observations on the nature and relations of the desert flora, and on the probable origin of the Australian flora as a whole." The author briefly sketched the physical and botanical features of the West Australian desert, indicating the parallel of 30° S. as, at least in the Coolgardie district, the dividing line between two subfloras. Flowering takes place almost entirely in spring-time, when alone the conditions are favourable to it. Statistics of the desert-flora were then given. These comprise 867 known species, of which 860 are Phanerogams, referable to 319 genera, distributed among 73 natural orders. Of the flora 58 per cent. consist of species ranged under 8 orders, with *Compositae* and *Leguminosae* heading the list, leaving 42 per cent. to be shared between the remaining 65 orders. The author disbelieved the current theory of Scandinavian predominance; and the prevalence in Eastern Australia of forms of Indo-Malayan facies was held to be due, in great measure, not to immigration, but to descent from the primitive Tertiary flora. Moreover, the balance of exchange between Indo-Malaya and Australia in favour of the former area, was considered as coming under the doctrine of chances, and not as implying any inherent superiority of the one flora over the other. While in Europe the Australian, *i.e.* the xerophilous, element was, owing to change in climate, eliminated in favour of the present hygrophilous vegetation, in Eastern Australia the conditions remained as they were in earlier Tertiary times until desiccation set in. He held that this desiccation dates from an earlier period in Western Australia; and that this, together with the isolation of the Western portion of the continent in Secondary times by a sea, and later by stretches of desert, explains the floristic difference between the two halves of Australia.—Mr. C. B. Clarke, F.R.S., made some observations on the origin of the Australian flora, and on the dispersal northwards of species from the Antarctic.—The President made some remarks by way of comparing the botanical statistics mentioned by Mr. Moore with the results obtained by zoologists in Australia, both as regards the character and origin of the fauna.

Zoological Society, November 29.—W. T. Blanford, F.R.S., Vice-President, in the chair.—Mr. G. A. Boulenger, F.R.S., exhibited a dancing-stick from New Guinea, to which were attached as ornaments two imperfect skulls of the rare Chelonian *Carettochelys insculpta*, a species previously known only from a single specimen in the Australian Museum, Sydney. Mr. Boulenger also exhibited and made remarks upon a large female specimen of a sea-snake, *Distira stokesi*, which had been caught by Mr. F. W. Townsend in Kurrachee Harbour covered with a thick growth of green seaweeds.—Mr. C. W. Andrews

exhibited and made remarks on some bird remains which had been obtained from excavations at the Lake-dwellings near Glastonbury, Somersetshire, and among which were numerous bones of a Pelecan.—Mr. Oldfield Thomas read a letter which he had received from Señor Ameghino on the subject of the newly discovered mammal *Neomylodon*, giving further information, obtained from the Indians, as to its distribution, characters, and habits.—A communication was read from Dr. E. A. Goeldi on the Amazonian Lepidosiren, in which he recorded the capture of two further examples of this Dipnoan in the island of Marajo. Dr. Goeldi gave a short description of the physical features of the locality in which he had found Lepidosiren—a "pirisal" or papyrus-meadow. He also referred to the live specimen in his aquarium which had recently developed branches on its fore limbs. Dr. Goeldi pointed out the gill-like character of the fore limb, and adduced it as a support to the Gegenbaur theory of limbs. He also suggested the possibility that the so-called fore limb of Lepidosiren is not a true fore limb, but a persistent external gill. This paper was illustrated by the exhibition of three specimens of the Amazonian Lepidosiren, which Dr. Goeldi had forwarded for presentation to the British Museum.—Mr. F. G. Parsons read a paper on the anatomy of adult and foetal specimens of the Cape Jumping Hare (*Pedetes caffer*). In it the different systems—osseous, muscular, nervous, circulatory, digestive, &c.—were described in some detail, and contrasted with the corresponding parts in two Jerboas (*Dipus hirtipes* and *D. jerboa*).—A communication was read from Mr. F. O. Pickard-Cambridge on a small collection of spiders from Trinidad, West Indies. Specimens of six species were contained in the collection, of which three were described as new.—Mr. W. E. de Winton read some notes on the breeding of a female African Wild Ass (*Equus asinus*) in the Society's gardens, and called attention to certain facts as regards her offspring, which gave some support to the doctrine of telegony.—Mr. de Winton also read a paper describing the moulting of the King Penguin (*Aptenodytes pennanti*), as observed in a specimen in the Society's gardens. The author remarked that the specimen in question had lived in the gardens for sixteen months, and during that period had moulted only once.—A communication was read from Dr. A. G. Butler on a collection of butterflies made at Salisbury, Mashonaland, in 1898, by Mr. Guy A. K. Marshall. The collection contained specimens of sixty-five species, which were enumerated. Two new genera (*Torynesis* and *Tarsocera*) and one new species (*Aslanga marshalli*) were described in the paper.—Mr. G. A. Boulenger, F.R.S., read a third report on the additions to the Lizard Collection in the Natural History Museum, containing a list of this class (165 in number), new or previously unrepresented, of which specimens had been added to the collection since 1894.

CAMBRIDGE.

Philosophical Society, October 31.—Annual General Meeting.—Mr. F. Darwin, President, in the chair.—The following were elected officers for the ensuing year:—President, Mr. J. Larmor. Vice-Presidents: Mr. F. Darwin, Prof. Forsyth, Dr. Gaskell. Treasurer: Mr. Shipley. Secretaries: Mr. Newall, Mr. Bateson, Mr. Baker. Members of Council: Mr. H. Gadow, Mr. D. Sharp, Prof. J. J. Thomson, Mr. A. Berry, Mr. Wilberforce.—On the evaluation of a certain determinant, which occurs in the theory of statistics and of elliptic space, by Mr. A. Berry.—(1) Metrical relations between linear complexes, by Mr. J. H. Grace. In this paper are discussed the metrical relations which exist between the mutual moments and pitches of systems of four, five and six linear complexes. Some of the results are applied to a geometrical representation of a four-system of screws. (2) Apolar systems of quadrics.—Certain systems of quadratic complex numbers, by Mr. A. E. Western.—On Mittag-Leffler's theorem, by Mr. H. F. Baker.—The connection between the chemical constitution of a gas and the ionisation produced in it by Röntgen rays, by Prof. J. J. Thomson. The measurements of the ionisation produced by Röntgen rays in fourteen gases showed that the ionisation was connected with the chemical composition in a very simple manner. The ionisation was found to be an additive property.—On convection currents, and on the fall of potential at the electrodes in conduction produced by Röntgen rays, by Mr. J. Zeleny. During conduction through a gas exposed to Röntgen rays, convection currents are set up in the gas. When two parallel, plane electrodes are used, the motion of the gas begins symmetrically from the centre towards each of the plates. The motion is conveniently made visible by particles of ammonium chloride formed in the gas from ammonia and hydrochloric acid. Screening from the rays the space next to one of the electrodes increases the strength of the convection currents on that side. The cause of these currents is attributed to the motion through the gas near the electrodes of an unequal number of the two kinds of ions by means of which the conduction takes place.—On velocity of solidification, by Mr. H. A. Wilson. The relation between the velocity of solidification of a super-cooled liquid and the super-cooling has been investigated for a number of substances by G. Tammann and Friedländer (*Zeitschrift P. C.*, xxxiv. p. 152, 1897, and xxiii. p. 326, 1897). Assuming that the rate of solidification is directly proportional to the difference between the internal pressures in the liquid and solid and inversely proportional to the viscosity of the liquid, the velocity of solidification can be expressed by a simple formula.

November 28.—Mr. J. Larmor, President, in the chair.—(*a*) On the flame spectrum of mercury and its bearing on the theory of the distribution of energy in gases, by Prof. Liveing. The author had found that mercury heated in a flame of cyanogen, burning in oxygen, emitted at least two rays, at wave-lengths 2535 and 4358, which he had been able to photograph. The vibrations producing these rays must, he thought, be the result of a direct change of heat into vibratory energy; and if so, the ratio of the specific heats of mercury, at constant pressure and constant volume, proved only that, at the temperature of the compressed vapour in a sound wave, no very sensible proportion of the heat is converted into vibratory motion, though at a higher temperature a sensible proportion is so converted. This appears to negative the hypothesis that energy is always distributed equally in all the degrees of freedom of the molecules, as well as the assumption that a gas having 1·66 for the ratio of its specific heats must have monatomic molecules. (*b*) On the variation of intensity of the absorption bands of different didymium salts dissolved in water, and its bearing on the ionisation theory of the colour of solutions of salts. The author exhibited a series of photographs of the absorption bands produced by equivalent solutions of didymium nitrate and chloride, of which the strength was regularly graded, and the absorbent thickness varied.—Note on the vapour of iodine, by Prof. Dewar. The author had found that by careful distillation in vacuo films of iodine could be made so thin as to transmit light and exhibit the colours of thin plates by reflection. He exhibited experiments showing that at ordinary temperatures pure dry iodine emits vapour which, in a half-litre flask containing air, is sensibly coloured, whereas in similar circumstances, except that the air pressure was reduced, the colour is much less. This difference is enhanced as the temperature rises, so that at 100° it is very marked in a tube of only 1 cm. diameter.—On the partitions of numbers which possess symmetrical graphs, by Major Macmahon, F.R.S.

MANCHESTER.

Literary and Philosophical Society, November 15.—Mr. J. Cosmo Melvill, President, in the chair.—Dr. G. H. Broadbent described the development and life-history of *Vorticella putrina* by means of thirty-four diagrams made from his own investigations. The cyst is circular in shape, the contents being finely granular, and the only indication of life is given by the contractile vesicle. This at first contracts at rare intervals and very slowly, and after a time an oral canal appears which gradually becomes more distinct, whilst the contractions of the vesicle grow more frequent. When the vorticella emerges from the cyst, a small portion is at first protruded through a very small aperture in the cyst-wall, in shape like a bladder, this gradually increasing in size until the whole creature has emerged, the aperture meanwhile appearing not to increase in the least. It is remarkable that after full extrusion the cyst-wall remains as large and as circular as before, whilst the organism is much larger than the cyst, and the vesicle greatly increased in size, thus indicating that the creature has been under great pressure in the cell. After emerging, the vorticella may remain quiescent for a time, until the basal cilia are developed, when it swims rapidly away as a "free-swimming" form. It afterwards attaches itself by the basal portion to some foreign body, and begins to shoot out a stalk which increases in length, while cilia are developed at the oral end. "Detached" as distinguished from "free-swimming" forms

were described, and it was shown that the development of basal cilia was always identified either with attachment to or detachment from the stalk.

DUBLIN.

Royal Dublin Society, November 16.—Mr. W. E. Wilson, F.R.S., in the chair.—Sir Howard Grubb, F.R.S., Vice-President of the Royal Dublin Society, read a paper on the correction of errors in the distribution of time signals. After referring to the various methods that are in use for the purpose of time distribution and the difficulties to be overcome, he described a system which he had recommended for a large institution in England, in which the conditions were somewhat similar to those of the Royal Dublin Society, though on a very much larger scale. He proposed that the best regulator clock should be procured and made to serve as the controlling clock of the whole system, which, however, would be further checked once every twenty-four hours by a signal from Greenwich, this being very much the same system as adopted at the Royal Dublin Society. The controlling clock, however, in this case he proposed should be sealed up in an air-tight case and in an atmosphere of nitrogen, and this placed in an outer case, or jacket, also containing nitrogen. By this means a constant pressure can be kept in the inside case, and with due precautions such a clock can be kept under conditions of constant pressure and temperature, and therefore should be expected to give extremely good results. This clock is then used to control a piece of uniform motion clock worked by a device very similar to what he has adopted with such success for his astronomical instruments, which has now been tested for several years and given excellent results. This piece of uniform motion clock is further checked by the Greenwich signal, it being supplied with a device by which the services of a human being to receive the signal and correct the clock are dispensed with. By an automatic arrangement the signal is received by this clock and corrected by exactly the amount it varies at that moment from the true time, and further a register is made of the amount of that correction, which can be afterwards inspected and noted. This uniform motion clock then serves as the central or distributing clock for some 200 other clocks spread throughout the building, which are practically only dials worked from this distributing clock.—Prof. G. A. J. Cole exhibited a method of intensifying the coloration imparted to a Bunsen flame by potassium in silicates. The minute assay is decomposed in a bead of sodium carbonate, as described in the *Geological Magazine*, March 1898. The method is of service in estimating the nature of the undifferentiated ground mass in many igneous rocks.

PARIS.

Academy of Sciences, November 28.—M. Wolf in the chair.—On the relation which exists between the progressive motion and the motion of inclination in the safety bicycle, by M. J. Boussinesq.—A differential method for determining variations of latitude and the constant of aberration, by M. G. Bigourdan. The method described is purely differential, and hence the results are free from errors inseparable from absolute measurements. It is independent of the stability of the telescope, and since only zenithal stars are employed, practically independent of refraction.—On the measurement of small diameters, by M. Maurice Hamy. The application of the interference method of Fizeau and Michelson is difficult for faint stars, the bands being scarcely visible. In the modification suggested the slits have a width which is appreciable compared with the distance of their centres, and hence the formula of Michelson is inapplicable. An approximate formula for the method thus modified is developed by the author. On some types of partial differential equations of the second order, by M. E. Goursat.—On orthogonal systems, by M. Tzitzéica.—On the complex multiplication of Abelian functions, by M. G. Humbert.—The mechanical equivalent of heat and the specific heats of gases, by M. A. Leduc. An application of the formulae developed in previous papers to determination of J from air and carbon dioxide. The deviations found are very large, and are due to the difficulty of measuring accurately the specific heat at constant pressure of a gas. The inverse calculation of this latter constant from the experimental value of the mechanical equivalent would probably be the better application of the formulae.—On condensed oxides of rare earths, by MM. G. Wyrouboff and A. Verneuil. The power of polymerising with great ease under a variety of conditions is especially characteristic of the ceroso-ceric group of oxides, and many reactions in this group can be more satisfactorily explained by this hypothesis than by the assumption of the formation of basic salts.—Observations on the spectra of aluminium, tellurium, and selenium, by M. A. de Gramont.—On the aromatic urethanes of tetra-hydroquinoline, by MM. Cazeneuve and Moreau. The urethanes were obtained by the action of an excess of tetra-hydroquinoline upon the carbonates of phenyl, ortho-chloro-phenyl, methoxy-phenyl, and α-naphthol.—On pulegenacetone, by M. Ph. Barbier.—Action of potash upon oxynitrocellulose, by M. Léo Vignon. The chief product of this reaction is oxypyruvic acid, $CH_2(OH).CO.CO.OH$.—On a new crystalline principle extracted from *Artemisia absinthium*, by MM. Adrian and A. Trillat.—Researches on the means of increasing the adhesive power of copper solutions used for spraying diseased vines, by M. Joseph Perraud. Of the various substances tried, colophane proved to be by far the most effective, soap being the next useful.—Composition and food value of cheese, by M. Balland.—On a method of colouring living protoplasm by the pigments of fungi, by M. L. Matruchot.—Influence of anaesthetics on the formation of chlorophyll, by MM. E. C. Teodoresco and Henri Coupin. Chloroform or ether prevent the production of chlorophyll in etiolated plants exposed to the light. Used in quantities too small to completely prevent the formation of chlorophyll, the production of the green colouring matter was greatly retarded.—Geobotanical study of the flora of the high basins of the Sallanche and Trient, by M. Paul Jaccard.—On the discovery of fossils in the layers constituting in Provence the formation called *étage de Vitrolles*, and on the limit of the Cretaceous and Tertiary beds in the basin of Aix Bouches-du-Rhône, by M. G. Vasseur.—Measures proposed to avoid collisions at sea, by M. E. Lacoine.—Remarks concerning the green ray, by M. Piot-Bey.

NEW SOUTH WALES.

Royal Society, September 7.—Mr. G. H. Knibbs, President, in the chair.—Key to tribes and genera of Melanospermeae (olive-green seaweeds), by R. A. Bastow.—A study of the dialects of New Caledonia, by Jules Bernier, curator of the Musée Néo-Caledonienne. No less than twenty dialects are distinguished in New Caledonia, which are grouped into the following main divisions: the Southern, inclusive of the Isle of Pines; the Central; the Northern; and those parts of the Loyalty Islands peopled by Melanesians.—An interesting collection of photographs from the Don Dorrigo and Brush districts, New South Wales, chiefly geological, were shown by his Honour Judge Docker.—A new Eucalyptus oil was exhibited by Messrs. Baker and Smith of the Technological Museum, Sydney. On rectification this oil was found to contain a fraction boiling between 280°-290° C., equalling 18 per cent. of the whole, and which consisted almost entirely of eudesmol, comparatively in a pure condition. The fraction wholly crystallised in less than one hour.—The latest type of polariscope (Wright-Newton projecting polariscope) was exhibited by Dr. F. H. Quaife.

Linnean Society, October 26.—Prof. J. T. Wilson, President, in the chair.—On *Carabidae* from West Australia, sent by Mr. A. M. Lea (with descriptions of new genera and species, synoptic tables, &c.), by Thomas G. Sloane.—Descriptions of new species of Australian Coleoptera, Part v. by Arthur M. Lea.—A statistical note on variations in the flowers of *Anguillaria dioica*, R.Br., by C. T. Musson. As is well known, *Anguillaria dioica*, R.Br. (N.O. *Liliaceae*), is widely distributed in extra-tropical Australia and Tasmania, and occurs under three forms—with male flowers only (without even rudimentary pistils), with female flowers only (without even rudimentary stamens), and in a polygamous condition (with male, and hermaphrodite flowers). But whether or no all three forms occur together throughout the area of distribution, and if so in approximately what relative numerical proportions are matters not ascertainable from present records. From the data collected it would appear that in the locality mentioned the tendency towards the condition of dioecism has reached an advanced stage.—Mr. North exhibited the skin of a fledgling fan-tailed cuckoo, *Cacomantis flabelliformis*, which he had caught on October 3 in a gully at Chatswood. It was being fed by its foster parents, a pair of rock warblers, *Origma rubricata*, whose nest was found in a dark recess in the rocks a few feet away. Usually the egg or young of this parasite is found in domed nests built in situations which are more or less exposed to the

sun's rays. That it is not a solitary instance of this cuckoo depositing its egg in the nest of this gloom-loving species is borne out by the fact that the same pair of rock warblers built again in a rocky chamber about two hundred yards away from their previous nesting site.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 8.

ROYAL SOCIETY, at 4.30.—Effects of Prolonged Heating on the Magnetic Properties of Iron: S. R. Roget.—On the Topographical Anatomy of the Abdominal Viscera, especially the Gastro-intestinal Canal: Prof. Addison.—Mathematical Contributions to the Theory of Evolution. VI. Reproductive Selection. Part I. Theoretical: Prof. Pearson. Part II. On the Inheritance of Fertility in Man: Prof. Pearson and Miss Lee. Part III. On the Inheritance of Fecundity in Thoroughbred Racehorses: Prof. Pearson, with assistance of L. B. Moore.—Nitragin and the Nodules of Leguminous Plants: Miss Maria Dawson.

MATHEMATICAL SOCIETY, at 8.—On Groups of the Order $pq\beta$: Prof. Burnside, F.R.S.—On Simultaneous Partial Differential Equations: J. E. Campbell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Improvement in Magnetic Space Telegraphy: Prof. Oliver Lodge, F.R.S.——And, if time permit: Telegraphy by Magnetic Induction: Sydney Everard.

FRIDAY, DECEMBER 9.

PHYSICAL SOCIETY, at 5.—Longitudinal Vibrations in Solid and Hollow Cylinders; Dr. C. Chree, F.R.S.—On the Thermal Properties of Normal Pentane: J. Rose-Innes and Dr. Sydney Young F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 8.—The Division Errors of the Greenwich Transit-Circle: F. W. Dyson and W. G. Thackeray.—On a New Instrument for Measuring Astrophotographic Plates: Dr. David Gill.—Observations of the Leonids, 1898 November, made at Cambridge Observatory: A. R. Hinks.—Note on the Effect of Wear on the Errors of Micrometer Screws: Dr. David Gill.—On a Probable Instance of Periodically-Recurrent Disturbances on the Surface of Jupiter: W. F. Denning.—Observations of Comet Coddington (*c* 1898): John Tebbutt. The Extra-Equatorial Currents of Jupiter during the Apparition of 1897-98: Rev. T. E. R. Phillips.

MALACOLOGICAL SOCIETY, at 8.—Notes on a Third Collection of Marine Shells from the Andaman Islands, with Descriptions of New Species of *Mitra*: J. Cosmo Melvill and E. R. Sykes.—Description of Three New Species of Marine Shells from N.W. Australia: Edgar A. Smith.—The Melaniidae, a Heterogeneous Family: J. E. S. Moore.—On the Affinities of *Donovania* (*Lachesis*) *minima*: M. F. Woodward.

MONDAY, DECEMBER 12.

SOCIETY OF ARTS, at 8.—Acetylene: Prof. Vivian B. Lewes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Exploration in the Caroline Islands: F. W. Christian.

TUESDAY, DECEMBER 13.

ZOOLOGICAL SOCIETY, at 8.30.—On the Cerebral Convolutions of the Gorilla: F. E. Beddard, F.R.S.—On certain Characters of Reproduced Appendages in Arthropoda, and particularly in the *Blattidae*: H. H. Brindley.—Contributions to the Osteology of Birds. Part II. Impennes: W. P. Pycraft.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Paper to be discussed: The Ventilation of Tunnels and Buildings: Francis Fox.

ROYAL STATISTICAL SOCIETY, at 5.30.

WEDNESDAY, DECEMBER 14.

SOCIETY OF ARTS, at 8.—Commercial Education: Sir Albert Rollit.

THURSDAY, DECEMBER 15.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Reciprocal Innervation of Antagonistic Muscles. Fifth Note: Prof Sherrington, F.R.S.—The Action of Magnetised Electrodes upon Electrical Discharge Phenomena in Rarefied Gases. Preliminary Note: C. E. S. Phillips.—Observations on the Anatomy, Physiology, and Degenerations of the Nervous System of the Bird: Prof. Rubert Boyce and Dr. W. B. Warrington.—Note on the Densities of Atmospheric Nitrogen, Pure Nitrogen, and Argon: Prof. W. Ramsay, F.R.S.

LINNEAN SOCIETY, at 8.—Sketch of the Zoology and Botany of the Altai Mountains: H. J. Elwes, F.R.S.—A Description of some Marine and Freshwater Crustacea from Franz Josef Land, collected by W. S. Bruce, of the Jackson-Harmsworth Expedition: Thos. Scott.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

CHEMICAL SOCIETY, at 8.—The Interaction of Ethylic Sodiomalonate and Mesityl Oxide: Dr. A. W. Crossley.—Derivatives of Camphoric Acid, Part III.: Dr. F. S. Kipping, F.R.S.—Synthesis of $\alpha\beta\beta$ Trimethylglutaric Acid: H. Perkin, jun., F.R.S., and Dr. J. F. Thorpe.

FRIDAY, DECEMBER 16.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Kentish Town Widening, Midland Railway: Walter Daniel.

QUEKETT MICROSCOPICAL CLUB, at 8.

BOOKS, PAMPHLET, SERIALS, &c., RECEIVED.

BOOKS.—The Tutorial Algebra: W. Briggs and G. H. Bryan, Part 2 (Clive).—Elementary Botany: Prof. G. F. Atkinson (New York, Holt).—Through New Guinea and other Cannibal Countries: H. Cayley-Webster (Unwin).—Flora Capensis, Vol. vi. (Reeve).—Flora of Tropical Africa, Vol. vii. (Reeve).—Geological Survey of Canada, Annual Report (new series), Vol. ix., 1896 (Ottawa, Dawson).—Physical Chemistry for Beginners: Dr. van Deventer, translated by Dr. R. A. Lehfeldt (Arnold).—My Horse; my Love: S. Buckman-Linard (Unwin).—Matter, Energy, Force and Work (Prof. S. W. Holman (Macmillan).—Prismatic and Diffraction Spectra: J. von Fraunhofer (Harper).—The Free Expansion of Gases; Gay-Lussac, Joule and Thomson (Harper).

PAMPHLET.—Chemische Technologie, &c.: Dr. F. Fischer (Braunschweig, Vieweg).

SERIALS.—Bulletin of the American Mathematical Society, November (New York, Macmillan).—Encyklopädie der Mathematischen-Wissenschaften, Band 1, Heft 1 (Leipzig, Teubner).—Journal of the Asiatic Society of Bengal, Vol. lxvii. Parts 170, 171 and 173 (Calcutta).—Proceedings of the Royal Society of Edinburgh, Vol. xxii. No. 2, Pp. 137-248 (Edinburgh).—Zoologist, November (West).—American Naturalist, November (Ginn).—Transactions of the Academy of Science of St. Louis, Vol. vii. Nos 17 to 20 (St. Louis).—Agricultural Gazette of New South Wales, September (Sydney).—Bulletin de la Société Imperiale des Naturalistes de Moscou, 1898, No. 1 (Moscou).—Monthly Weather Review, October (Washington).—Longman's Magazine, December (Longmans).—Chambers's Journal, December (Chambers).—Good Words, December and Christmas (Isbister).—Sunday Magazine, December and Christmas (Isbister).—Bulletin of the Liverpool Museums, October (Liverpool).—Contemporary Review, December (Isbister).—Astrophysical Journal, November (Chicago).—Natural Science, December (Dent).—National Review, December (Arnold).—Fortnightly Review, December (Chapman).—Scribner's Magazine, December (Low).—Photogram, December (Dawbarn).—Kew Bulletin, Additional Series, ii. (Eyre).—Century Magazine, December (Macmillan).—Humanitarian, December (Duckworth).—Zeitschrift für Physikalische Chemie, xxvii. Band, 3 Heft (Leipzig).—L'Anthropologie, tome ix. No. 5 (Paris).—Knowledge, December (Witherby).

Bacon's Chart of Common Poisonous Plants (Bacon).

CONTENTS.

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